[redacted]

Draft of speech by Admiral Turner before the

Business Council meeting in Denver, October 1977

 [redacted]

29 September 1977

I. For over 25 years, CIA has been the major producer of economic intelligence in the US government.

A. In the 1950s and 1960s, we concentrated mainly on the Communist economies. We now devote substantial analytical resources to non-Communist countries as well -- both developed and less developed.

B. We produce intelligence using a regional approach -- West European countries, the USSR, Japan, South Africa, India, etc. -- and a functional approach -- energy, world food production, the North-South dialogue, multilateral trade negotiations, and others.

II. The Soviet economy has been a unique concern of CIA from the beginning, but our emphasis has changed over the years, largely as a function of evolving national security perceptions:

A. Until the late 1960s, we concentrated our resources on analyzing the ability of the Soviet economy to support military programs.

B. Since then, because of US concern with improvement of US-USSR economic relations, more resources have been devoted to research on East-West trade matters.

C. Because of renewed concern about Soviet military programs and indications of growing Soviet economic difficulties, we recently have supplemented our analytical resources.

III. Research on the Soviet economy poses special analytical problems because of the relative paucity and poor quality of the data. We try to overcome this problem by:

A. Carefully combing all relevant open source materials, including two dozen Soviet newspapers, more than a hundred Soviet periodicals, all Soviet official statistical publications, and numerous Western specialized and general publications.

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[redacted]

B. Using information collected through unique intelligence sources.

C. Developing more sophisticated techniques of analysis, including the latest econometric methods.

IV. We have recently completed a major review of the Soviet economy. The thrust of this study is that the economic outlook is more bleak and the prospects for policy choices more uncertain than at any time since Stalin's death.

A. The USSR will soon enter a period of reduced growth potential with possible bottlenecks in key commodities, especially oil, which could reduce growth even further.

B. The basic problem is that the formula for growth used over the last 25 years -- maximizing crude inputs of labor and capital -- will no longer work.

C. Moscow also will be confronted with a new set of difficult policy problems, especially involving energy use, imports from the West, relations with Eastern Europe, and the size of their armed forces.

V. The reasons for poor Soviet economic prospects include the following:

A. The number of new entrants into the labor force will become much smaller in the 1980s -- the result of reduced birth rates in the 1960s.

5 year plan
Labor
Capital
Prod

B. Productivity gains have been slowing for years and new problems likely will depress productivity.

C. The Soviets also are going to face an energy crisis. They are not finding and developing new oil deposits rapidly enough to offset declines in older fields. As a result, production will begin to fall in the late 1970s or early 1980s. For example, we expect oil production by 1985 to be between 8 and 10 million barrels per day -- far below what we estimate to be the maximum potential of 11-12 million barrels per day.

1. The Soviets will need US-made high capacity submersible pumps to stave off or slow the expected fall in production even temporarily.

2. Beyond the mid-1980s, the USSR is counting on developing large new supplies of energy -- including coal, natural gas, hydroelectric power as well as oil -- most of which are located in remote areas of the country.

3. The development of these energy sources, however, will not prevent the rate of growth of energy output from falling sharply in 1981-85.

VI. If the USSR does not have sufficient energy to support desired levels of economic growth, then it will face a turn-around from its present net energy export position to a net import position. However, the longer the USSR delays adoption of a top-priority energy program, the greater will be the economic impact in the 1980s.

VII. A marked reduction in the rate of economic growth in the 1980s seems inevitable.

A. A plausible forecast is a growth of GNP of about 4 percent a year through 1980, and roughly 3 percent in 1981-85. By comparison, growth averaged 4-1/2 percent in the past decade.

B. Economic growth could be further constrained by an energy shortage if the output of oil falls to the lower end of the expected range as noted above.

C. The reduced growth potential means that the Soviet consumer will fare poorly during the next five to ten years relative to recent gains.

VIII. There are a number of important implications to be drawn from what I have recounted above.

A. The slowdown in economic growth is likely to trigger intense debate in Moscow over the future levels and patterns of military expenditures. Although military programs have great momentum and powerful political and bureaucratic support, ways to reduce the growth of defense expenditures should become increasingly attractive to major elements of the Soviet leadership.

B. Moscow's economic problems in the 1980s will strongly affect its relations with the West, especially the US.

1. Oil accounts for one-half of the USSR's hard currency earnings. With the projected decline in oil available for export, Soviet ability to import from the West in the 1980s will almost certainly suffer.

2. Moscow, therefore, may ask for long-term credit, especially to develop energy resources. A great deal of advanced US technology will be needed to do this rapidly.

C. Eastern Europe may be hit hard by Soviet decisions in oil.

1. Soviet commitments call for Eastern Europe to get 1.6 million b/d by 1980, a diversion of about $7 billion in potential Soviet earnings.

2. There will be strong pressure to force Eastern Europe to share the burden of the Soviet oil shortage, but a substantial cut in oil supplies to Eastern Europe would worsen its already difficult economic situation and may threaten political stability there.

D. Soviet and East European demands for oil imports in the 1980s could impact adversely on the world oil market.

1. Increased Communist demand will coincide with both rising oil prices and insufficient OPEC capacity to meet Free World demand.

2. This could advance the timing of the projected world oil supply crunch and exacerbate the price run-up required to bring world supply and demand into balance.

E. Soviet responses to economic problems will be complicated severely by the uncertainties surrounding the inevitable change in leadership in the next few years. Not until a new and vigorous leadership is in power is it likely that the Politburo will come to grips with the difficult problems of the Soviet economy.

IX. The USSR as well as Eastern Europe are already experiencing economic difficulties. These problems are reflected in their hard currency balance of payments.

A. For a number of reasons, including the need to import grain and poor performance in Western export markets, the USSR and Eastern Europe have run up large hard currency trade deficits.

B. In 1976, their combined deficits were about $12 billion, of which the USSR accounted for approximately $5 billion, Poland about $3 billion, and East Germany roughly $1 billion.

C. These countries have borrowed heavily in the West to finance their deficits. The Soviet and East European debt more than doubled in two years to about $40 billion at yearend 1976. (See table, page 9).

1. Roughly one-half of the outstanding debt derives from Western government-backed credits extended at subsidized interest rates; the remainder was borrowed from banks at market rates.

2. At the end of 1976, the USSR had amassed a hard currency debt of $14 billion, followed by Poland with more than $10 billion and East Germany almost $5 billion.

D. Western governments have been eager to offer credits to the USSR and Eastern Europe to expand their export markets.

1. As of the end of 1976, France had committed more government-backed export credits than any other country -- $6.8 billion -- followed closely by West Germany. The United Kingdom and Italy are also major lenders. The United States ranks well down the list of creditors because of restrictions on Eximbank lending. Total US commitments are less than $1 billion, split roughly between the USSR and Poland.

2. Growing Western concern about credit-worthiness of the USSR and Eastern Europe has helped bring about the so-called "Gentleman's Agreement" among major Western governments. This accord sets repayment terms in order to avoid credit competition among lenders.

USSR and Eastern Europe: Net Hard Currency Debt*
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	1973	1974	1975	1976
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REDRAFT OF TALK AT THE BUSINESS COUNCIL

HOT SPRINGS, VIRGINIA

October 1977

I. We have recently completed a major review of the Soviet economy. The thrust of this study is that the economic outlook is more bleak and the prospects for policy choices more uncertain than at any time since Stalin's death.

A. The USSR will soon enter a period of reduced growth potential with possible bottlenecks in key commodities, especially oil, which could reduce growth even further.

B. The basic problem is that the formula for growth used for over the last 25 years -- maximizing crude inputs of labor and capital -- will no longer work.

C. Moscow also will be confronted with a new set of difficult policy problems, especially involving energy use, imports from the West, relations with Eastern Europe, and the size of their armed forces.

D. These difficult policy issues may very well arise at a time of changing leadership inside the Soviet Union.

II. The reasons for poor Soviet economic prospects include the following:

A. Labor input will be down. Soviet labor forces has been growing at a rate of 1.7 percent a year for the last __ years. We project that by the early 1980s it will be growing at only a rate of about 1/2 percent a year. This is a result of reduced birth rates in the 1960s, and anticipate this condition will persist through[illegible].

B. Capital Inputs. Capital inputs will also be down for a number of reasons:

1. Raw materials are simply becoming more expensive and difficult to obtain because the Soviets are having to reach further and further into the remote areas.

a. The Soviets also are going to face an energy crisis. They are not finding and developing new oil deposits rapidly enough to offset declines in older fields. As a result, production will begin to fall in the late 1970s or early 1980s. For example, we expect oil production by 1985 to be between 8 and 10 million barrels per day -- far below what we estimate to be the maximum potential of 11-12 million barrels per day.

(1) The Soviets will need US-made high capacity submersible pumps to stave off or slow the expected fall in production even temporarily.

(2) Beyond the mid-1980s, the USSR is counting on developing large new supplies of energy -- including coal, natural gas, hydroelectric power as well as oil -- most of which are located in remote areas of the country.

(3) The development of these energy sources, however, will not prevent the rate of growth of energy output from falling sharply in 1981-85.

(4) If the USSR delays adopting a top priority energy conservation program, the rate of growth of energy output will not match that of demand. The Soviet Union could even face a turn-around from its present net energy export position to a net import position. This is not to say the Soviets will actually end up being an importer of energy, simply that they will find themselves constrained to take any one of a number of alternatives to finding the hard currency to import energy.

2. The demands of modern technology are particularly onerous for the Soviet economy and slow down the rate of capital input.

C. The Soviets' own five-year plan acknowledges a reduction in the input of labor and of capital, but at the same time predicts an increase in overall productivity. We feel this is highly unlikely. There is no indication that their past record of

inefficient economic management is likely to be rectified, let alone improved enough to compensate for the reductions in labor and capital inputs. Moreover, we feel it unlikely that they would ideologically be able to accommodate a major change in their approach to management of their economy.

III. A marked reduction in the rate of economic growth in the 1980s seems inevitable.

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D. Moscow's economic problems in the 1980s will strongly affect its relations with the West, especially the US.

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Form 160c (13)
3-65

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TO	NAME AND ADDRESS	DATE	INITIALS
1	Maurice Ernst, D/OER		
2			
3			
4			
5			
6	Return to DCI		

	ACTION		DIRECT REPLY		PREPARE REPLY
	APPROVAL		DISPATCH		RECOMMENDATION
	COMMENT		FILE		RETURN
	CONCURRENCE		INFORMATION		SIGNATURE

Remarks:

1. Please fill in the blanks and check over. Also, may I have anything more to read about paragraph IX of old draft about the current problems in the Eastern Bloc.

(NOTE: DCI departing for Hot Springs at 1600 on 13 October.)

FOLD HERE TO RETURN TO SENDER

FROM: NAME, ADDRESS AND PHONE NO.	DATE
DCI	12 Oct 77

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(40)

FORM NO. 237 Use previous editions
1-67

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October 1977

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(3) The development of these energy sources, however, will not prevent the rate of growth of energy output from falling sharply in 1981-85.

4. Even if the USSR delays adopting a top priority energy conservation program, the rate of growth of energy output will not match that of demand. The Soviet Union consequently will have to reduce its energy exports. Depending on how energy supplies are divided between domestic and foreign users, the USSR could even face a turn-around from its present net energy export position to a net import position.

2. The demands of modern technology are particularly onerous for the Soviet economy and slow down the rate of capital input.

C. The Soviets' own five-year plan acknowledges a reduction in the input of labor and of capital, but at the same time predicts an increase in overall productivity. We feel this is highly unlikely. There is no indication that their past record of

inefficient economic management is likely to be rectified, let alone improved enough to compensate for the reductions in labor and capital inputs. Moreover, we feel it unlikely that they would ideologically be able to accommodate a major change in their approach to management of their economy.

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B. Eastern Europe may be hit hard by Soviet decisions in oil.

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2. There will be strong pressure to force Eastern Europe to share the burden of the Soviet oil shortage, but a substantial cut in oil supplies to Eastern Europe would worsen its already difficult economic situation and may threaten political stability there.

C. Soviet and East European demands for oil imports in the 1980s could impact adversely on the world oil market.

D. Moscow's economic problems in the 1980s will strongly affect its relations with the West, especially the US.

1. Oil accounts for one-half of the USSR's hard currency earnings. With the projected decline in oil available for export, Soviet ability to import from the West in the 1980s will almost certainly suffer.

2. Moscow, therefore may ask for long-term credit, especially to develop energy resources. A great deal of advanced US technology will be needed to this rapidly.

V. Soviet responses to economic problems will be complicated severely by the uncertainties surrounding the inevitable change in leadership in the next few years. Not until a new and vigorous leadership is in power is it likely that the Politburo will come to grips with the difficult problems of the Soviet economy.

VI. The problems of fewer resources at higher costs already are beginning to take their toll.

A. The pace of the Soviet economy, which slowed sharply last year, is continuing to drop despite a second relatively good year for agriculture.

B. We estimate Soviet 1977 GNP to grow by only 3-1/2 percent, compared with a 4 percent growth in 1976.

C. Industrial growth last year -- 3-1/2 percent -- was the slowest since World War II. The industrial sector remains hobbled by deficiencies in materials production, most notably a stagnation in ferrous metals output and a slowdown in the production of some chemical products.

VII. Soviet officials seem increasingly aware of the potential dangers of their looming energy and manpower problems.

A. They have acknowledged ~~claim, for example,~~ that their fuel industry could be seriously affected soon by the failure since 1975 to meet plans for increasing oil reserves in the key West Siberian basin.

B. Indications are that the Soviets are increasing ~~Spot shortages of fuel are showing up in a number~~ of ~~areas,~~ fuel conservation measures and may be considering more ~~suggesting that Moscow has begun adopting~~ stringent fuel allocation practices.

C. A number of recent Soviet articles indicate that the leadership is considering raising the retirement

ages to help offset the impending labor shortage. Such an action, however, would provide only a one-time boost to labor force growth, and would at best only dampen the projected slowdown in growth in the 1980s.

VIII. In recent years the East European economies also have been experiencing serious problems, particularly in consumer welfare.

A. The long drought of 1976 together with 1977 flooding in some countries has worsened the area's already difficult food supply situation, especially in Czechoslovakia, East Germany and Poland.

B. Polish officials have shown the greatest concern about consumer unrest--a necessity after the worker violence ensuing from the 1976 attempt to sharply raise food prices. Moreover, The ~~disastrous~~ poor ~~harvests~~ harvest this year will hinder the government's efforts to deal with chronic meat shortages~~, as well as to manage its burgeoning hard currency debt~~.

C. Shortages of coal and electricity also have added to consumer woes in Czechoslovakia, East Germany and Poland.

1. Priority allocation to industry, distribution bottlenecks, and, in the case of Poland, export commitments have resulted in LESS coal for home consumption.

2. Higher industrial demand in Poland and the failure to expand new capacity in Czechoslovakia have led to frequent power shortages in these countries.

IX. The USSR's current economic difficulties as well as those of Eastern Europe also are reflected in their hard currency balance of payments problems.

A. For a number of reasons, including the need to import grain and poor performance in Western export markets, the USSR and Eastern Europe have run up large hard currency trade deficits.

B. In 1976, their combined deficits were about ~~$12~~ $11 billion, of which the USSR accounted for approximately $5 billion, Poland about $3 billion, and East Germany roughly $1 billion.

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Speech not used

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A. They have acknowledged that their fuel industry could be seriously affected soon by the failure since 1975 to meet plans for increasing oil reserves in the key West Siberian basin.

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C. A number of recent Soviet articles indicate that the leadership is considering raising the retirement age to help offset the impending labor shortage. Such action, however, would provide only a one-time boost

to labor force growth, and would at best only dampen the projected slowdown in growth in the 1980s.

VIII. In recent years, the East European economies also have been experiencing serious problems, particularly in consumer welfare.

A. The long drought of 1976, together with the 1977 flooding in some countries, has worsened the area's already difficult food supply situation, especially in Czechoslovakia, East Germany, and Poland.

B. Polish officials have shown the greatest concern about consumer unrest -- a necessity after the worker violence ensuing from the 1976 attempt to sharply raise food prices. Moreover, the poor harvest this year will hinder the government's efforts to deal with chronic meat shortages.

C. Shortages of coal and electricity also have added to consumer woes in Czechoslovakia, East Germany, and Poland.

1. Priority allocation to industry, distribution bottlenecks, and, in the case of Poland, export commitments have resulted in less coal for home consumption.

2. Higher industrial demand in Poland and the failure to expand new capacity in Czechoslovakia have led to frequent power shortages in these countries.

IX. The USSR's current economic difficulties as well as those of Eastern Europe also are reflected in their hard currency balance of payments problems.

A. For a number of reasons, including the need to import grain and poor performance in Western export markets, the USSR and Eastern Europe have run up large hard currency trade deficits.

B. By 1976, their combined deficits were about $11 billion, of which the USSR accounted for approximately $5 billion, Poland about $3 billion, and East Germany roughly $1 billion.

C. These countries have borrowed heavily in the West to finance their deficits. The Soviet and East European debt more than doubled in two years, to about $40 billion at year end 1976. (See Table, page 11.)

1. Roughly 40 percent of the outstanding debt derives from Western-government and government-backed credits extended at subsidized interest rates; the remainder was borrowed from banks at market rates.

2. At the end of 1976, the USSR had amassed a hard currency debt of $14 billion, followed by Poland with more than $10 billion, and East Germany almost $5 billion.

D. Western governments have been eager to offer credits to the USSR and Eastern Europe to expand their export markets.

1. As of the end of 1976, France had committed more government-backed credits than any other country -- $6.8 billion -- followed closely by West Germany. The United Kingdom and Italy also are major lenders. The United States ranks well down the list of creditors because of restrictions on Eximbank lending. Total US commitments are less than $1 billion, split roughly between the USSR and Poland.

2. Growing Western concern about credit-worthiness of the USSR and Eastern Europe has helped bring about the so-called "Gentleman's Agreement" among major Western governments. This accord sets repayment terms in order to avoid credit competition among lenders.

USSR and Eastern Europe: Net Hard Currency Debt*
End of Year

Billion US$

	1973	1974	1975	1976
Total net debt	12.5	18.1	29.1	39.6
USSR	4.0	5.0	10.0	14.0
Poland	1.9	3.9	6.9	10.2
East Germany	2.1	2.8	3.8	4.9
Romania	2.0	2.6	3.0	3.3
Hungary	0.9	1.5	2.1	2.8
Czechoslovakia	0.8	1.1	1.5	2.1
Bulgaria	0.8	1.2	1.8	2.3

* Net debt refers to actual drawings less repayments of principal and interest. Excludes credit committed but not yet drawn down.

Requested Reading Material

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Czechoslovakia

Retail Price Increases

GT

7/27/77

Czechoslovakia has broken its seven-year freeze on retail prices but has avoided raising prices of politically sensitive basic foodstuffs. There will be some grumbling over the increases but significant public unrest is not likely. (C)

The price increases, announced on July 22, were applied primarily to goods produced from imports of Western raw materials. They cover eight categories, including chocolate (33-percent increase), coffee (50 percent), and cotton and wool products (34 percent). Prices were reduced on several categories of goods, such as color televisions (26-percent reduction), pocket calculators (40 percent), and synthetics (28 percent) that are produced domestically or in allied countries.

The government will probably place the blame for the increases on Western inflation. Recent Czechoslovak press reports have stressed the familiar theme that Czechoslovakia is a manufacturing country that has had to pay increasingly higher prices for its raw material imports from the West. The government also will emphasize that the price freeze on basic foodstuffs can only be maintained by increasing the prices of nonessential goods.

The US embassy reports that the increases had been rumored for some time, sparking a last-minute run on supplies of coffee, chocolate, and sugar. The price of sugar apparently was not increased.

The end of the price freeze is another signal to the Czechoslovak public that the government is no longer willing, or able, to subsidize all consumer goods. Last year, party leader Husak stated that stable prices on basic foodstuffs depended on improved economic productivity.

Despite the official price freeze since 1970, there has been substantial hidden price inflation through such techniques as repackaging old products and selling them at higher prices. There have also been seasonal fluctuations—sometimes dramatic—in official food prices, reflecting changes in supply. For example, potato shortages caused prices to triple last autumn. Such changes are only temporary and, as supplies improve, prices are returned to fixed base levels. (C)

G1 J2

EASTERN EUROPE

9/23/77

Poland: Financial Troubles

New information indicates that the Polish request for large concessionary US credits to finance agricultural purchases, reported in the *Daily* yesterday, stemmed in part from a Soviet refusal to supply Poland with additional grain and from pressing hard-currency problems. These problems also have reportedly led Polish officials to consider rescheduling Poland's Western debt. (S NF/OC)

25X1X

25X1X

[redacted] Warsaw recently approached Moscow for above-plan shipments of grain under the normal clearing arrangement. Above-plan shipments of Soviet grain and strategic raw materials to CEMA partners are usually paid for with hard-currency—or with goods that are marketable in the West.

The Soviets rejected the request, claiming that their excellent harvest was not expected to be a record one and that they could not provide grain in excess of the planned deliveries of 1 million to 1.5 million tons.

Poland's agricultural problems and hard-currency difficulties have led it to request a $500-million to $600-million credit from the US to finance purchases of agricultural imports through 30 June 1978. Most of the credit would be used to buy 4 million to 5 million tons of US grain.

Poland is also seeking credits of $400 million to $500 million annually for the next several years to finance agricultural purchases in the US. Ultimately, Warsaw would like to negotiate a long-term agreement with the US that would provide more generous credit terms, including a grace period and a lower interest rate, than those granted by the US Commodity Credit Corporation.

The Polish leadership is seriously concerned about the hard-currency debt. The reduction in hard-currency imports—5 percent in the first six months of this year—has been at great cost, according to the source. Imports of raw materials are being substantially cut, and output in some import-dependent industries is declining.

The leadership has discussed the option of debt rescheduling but considered it—as do the Soviets—unacceptable. Nevertheless, some high Polish officials—Chairman of the Planning Commission Wrzaszczyk and the Ministers of the Machine and Chemical Industries, in particular—privately are still considering the possibility of rescheduling Poland's Western debts. (S NF/OC) *-CIA, DIA, NSA-*

J2

9/7/77

Poland

The US Embassy in Poland reports that there were some shortages of flour in Warsaw and Poznan last week, but it notes that many stores appear well-stocked and people standing in line seem no more disgruntled than usual. The onset of good weather—after seven straight weeks of rain—probably has helped curb any inclination toward hoarding.

The government has apparently brought additional stocks onto the market both to demonstrate its ability to satisfy demand and to nip in the bud any potential hoarding. Moreover, the regime continues to press its message that despite the bad weather, supplies of foodstuffs—except for meat—will be sufficient. Serious shortages of meat and other foodstuffs still exist, however, and the regime will have to monitor the public mood carefully. (C) -*CIA, DIA, NSA*-

[redacted] [redacted]

THURSDAY 1 SEPTEMBER 1977

Poland: Signs of Consumers' Panic Buying

Harvest shortfalls caused by floods have resulted in hoarding of flour, rice, and groats by Polish consumers, and serious shortages of these staples could develop. The regime has told the public that supplies will be sufficient to meet demand, but such assurances will not satisfy consumers once they see empty shelves. (C)

Twice last week the Warsaw daily *Zycie Warszawy* published stories of "panicky" consumers who had been buying up available stocks of flour "for a rainy day." The paper admitted that "many" stores had run out of supplies.

We do not know how widespread the hoarding is, but the fact that this sensitive subject has been raised publicly is indicative of high-level concern. In recent years Polish consumers have been prone to hoard at the first sign or rumor of a shortage. Once a hoarding cycle begins, it is difficult to halt.

Last summer, consumers were convinced that there was a shortage of sugar, and the government finally had to impose rationing in order to assure equitable distribution. If it cannot quash the rumors or keep local stores supplied with grain staples this month, it could be forced to adopt another rationing plan.

The regime had been counting on a good harvest to help boost livestock production and thus curb discontent over continuing meat and other food shortages. This, the third successive inadequate grain harvest, will assure that discontent remains high and could exacerbate political infighting within the leadership. (C)

GT

9/22/77

POLAND: GLOOMIER AGRICULTURAL OUTLOOK

Unfavorable weather has further dampened Poland's harvest outlook, raising official fears of renewed panic buying of flour, rice, and cereals. A recent speech by Polish Premier Jaroszewicz reportedly was edited to substitute a categorical assurance of adequate food supplies for a vague pledge of government action. To make up for the likely shortfall in the harvest of grain and potatoes, Warsaw probably will press Moscow for more grain and seek additional US grain on credit.

Officials Worry About Consumer Reactions

Shortfalls are likely this autumn in the output of grain, fruit, vegetables, and potatoes because of the continued cool, cloudy, and rainy weather in Poland. Late in August, reports of harvest problems caused by rains and floods set off a buying spree, which cleared the shelves of staples in many stores. Although Polish officials contend that supplies of foodstuffs will be adequate, they complain of difficulty in allaying consumer doubts. Officials are fearful that continued reports about a poor harvest will cause another run on the stores and turn an uneasy economic balance into a political crisis.

Grain and Potato Harvests Down

We estimate that 1977 grain output will be about 20 million tons—nearly 2 million tons less than Polish officials had anticipated and almost 1 million tons less than last year's output. The milling and breadmaking quality of some of the grain has been adversely affected by the wet harvesting conditions. The wet weather also has hit the potato crop (an important source of feed for hogs) particularly hard, fostering the spread of blight; in past years, blight has reduced the potato crop between 10 and 30 percent.

Imports of Grain and Fodder Up

Because of the unfavorable harvest outlook, we expect grain import needs in the fiscal year ending 30 June 1978 to be between 6 million and 7 million tons, compared with imports of about 6 million tons last year. Imports of oilseed meal may exceed last year's purchases of about 1.1 million tons. Aside from bread-quality wheat, the composition of imports of grain and fodder for livestock will be determined largely by relative prices and availability of credits.

Polish officials are confident that the USSR will supply 1 million to 1.5 million tons of grain; they will probably press for more. According to the Polish Ambassador to the United States, Poland's purchases of US grain may total 4 million tons. Warsaw has applied for $300 million in Commodity Credit Corporation credits,

which would cover 3 million tons. So far $150 million in credits have been approved, including $135 million for about 1.5 million tons of grain. Purchases of grain on credit are also expected from Canada and France.

Meat Will Remain Scarce

Record imports of grain and feed are needed if the government is to prevent setbacks to its livestock program. Warsaw has been rebuilding animal holdings since livestock numbers tumbled in early 1976. Meat, nonetheless, remains scarce; even with substantial imports of feed grains, increased supplies of meat are not expected before mid-1978. Meanwhile, planned meat imports will not be sufficient to offset lower production, and per capita consumption will fall below last year's level. Shortages of fruit, vegetables, and potatoes will compound consumer dissatisfaction over meat shortages. (Confidential)

* * * * *

East Germany

HN

9/23/77

Fuel Restrictions

The East German Government has reportedly instituted nationwide measures to reduce motor fuel consumption. The restrictions may be related to East Germany's hard-currency payments problems. (SS)

So far, we have only scattered reports on the impact of the conservation measures. Truckers in the Potsdam area reportedly received less than half their normal fuel allotment for August. Reduced diesel fuel allocations evidently threatened to shut down road construction in that area.

Use of vehicles for commercial trips reportedly has been sharply curtailed, and some private motorists are faced with long lines at gas stations. We have no evidence yet of any impact on industry or agriculture.

Whatever the motivation for these restrictions, they clearly were not prompted by temporary difficulties in transportation or distribution. A regime directive calls for the reduction of gasoline and diesel fuel consumption by at least 5 percent in 1978.

The fuel cutbacks may be attributable to East Germany's hard-currency payments difficulties. Huge hard-currency trade deficits in the past few years have led to an attempt to reduce imports of high-cost oil from the Organization of Petroleum Exporting Countries. Existing Soviet - East German oil agreements call for deliveries to grow much more slowly during 1976-80 than in the previous five-year period. (SS)

8/18/77

Romania: Work Stoppage

MB

Romanian President Ceausescu reportedly was forced to intervene personally two weeks ago when a number of Romanian coal miners stopped work for several days to protest a new pension law. Work stoppages have been infrequent in Romania, but Ceausescu has interceded in the past when the situation has threatened to get out of hand. The incident was caused by the government's inept handling of a revised pension law, which fails to increase worker benefits as expected and postpones retirement eligibility for five years. (C)

The workers reportedly refused to discuss a settlement except with Ceausescu, who interrupted his vacation and was received by a shouting, fist-waving crowd of people who complained that life had been "better under capitalism." The miners returned to work after Ceausescu promised to review the pension changes. Several local officials are likely to become scapegoats.

The pension changes were the latest government effort to spur worker productivity and increase the size of the labor force. Men will now be required to work 30 years and women 25 years before they become eligible for retirement benefits.

Earlier, Ceausescu had lowered the government's goal for increased social services between 1976 and 1980 and raised the growth target for labor productivity from 9 percent to 10.4 percent annually. Romania's five-year plan calls for the construction of over one million new apartments—but only if the ambitious productivity target is reached.

The government's latest measures reflect Ceausescu's continued push for rapid economic growth despite growing constraints on labor, investment, and energy. The industrial labor force, which increased by more than 6 percent yearly between 1971 and 1975, probably will grow by only 3 to 3.5 percent annually between 1976 and 1980. In June, Ceausescu stated that 50,000 teachers and bureaucrats soon would be shifted into labor-short industry, with more large shifts to follow. (C)

8/18/77

Bulgaria: Growing Public Dissatisfaction

Public dissatisfaction evidently is growing in Bulgaria as rumors spread questioning the stability of the party leadership and as the economy worsens. Several fires in Sofia in recent weeks, including one in the office of the Communist Party's newspaper, may have been due to sabotage. (C)

According to the US embassy, rumors are circulating in Sofia that an anti-Zhivkov slogan appeared last week on one of the central bridges of the capital and was hastily removed by the authorities. This is the first such display of antiregime sentiment in recent years.

There appears to be widespread popular uncertainty in Bulgaria over the status of the leadership. The real reasons behind the firing of the regime's number-two man in May have not been explained, and there are now four vacancies on the 12-man Politburo. There are also rumors that party secretary Aleksandur Lilov, a protege of party leader Zhivkov, is seriously ill.

The US embassy believes that Zhivkov has not filled the vacancies on the Politburo because he is unwilling to bring potential rivals to the forefront.

Economic growth has slowed since 1975 largely due to Bulgarian attempts to improve its hard-currency balance-of-payments position. Saddled with the heaviest debt burden in Eastern Europe, the Bulgarians have sharply cut their imports from the developed West while boosting exports at the expense of the domestic market. In the first half of 1977, industrial production rose only 7.7 percent, well below the plan of 9.2 percent for the year. Agricultural production also got off to a poor start because of a spring drought and some frost damage to fruits and vegetables.

Gains for the Bulgarian consumer—already one of the poorest in Eastern Europe—have further slowed this year. Plans to boost services substantially have fallen flat, and apparently the regime has not made much headway in providing a better quality or selection of goods. The recent drought and frost damage to fruit and vegetables will aggravate the situation; the regime probably will divert much of these important hard-currency earners to the foreign market. Consumer grumbling is growing, but there is little likelihood that dissatisfaction will mushroom into widespread antiregime demonstrations. (C) *-CIA, DIA, NSA-*

Prospects for Soviet Oil Production
A Supplemental Analysis

ER 77-10425
July 1977

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Prospects for Soviet Oil Production
A Supplemental Analysis

Central Intelligence Agency
Directorate of Intelligence

July 1977

Overview

This report is a compilation of some of the data and analysis employed in the recent CIA study on the Soviet oil industry. The study concluded that Soviet oil production will soon peak, possibly as early as next year and certainly not later than the early 1980s. The maximum output reached is likely to be between 11 and 12 million barrels per day (b/d)–up from the 1976 level of 10.4 million b/d. Maximum levels are not likely to be maintained for long, however.

The Soviet Government is certainly aware of problems in increasing and sustaining oil production. Its own analysis emphasizes that the costs of finding and developing oil are rising dramatically. The Soviets apparently believe that they can avoid the downturn we predict. We disagree. We believe that even though great efforts will provide them with considerable oil, they cannot prevent the downturn.

Soviet efforts to solve the oil problem are reflected in the rapid increase in purchases of oil equipment abroad. Since 1971, Soviet orders for Western oil and gas equipment have totaled about $3.1 billion. An additional $4 billion worth of steel pipe has been bought. Plans to convert the giant Samotlor field as well as smaller West Siberian fields to gas-lift production could sharply escalate Soviet equipment purchases. The Samotlor project alone would require at least $1 billion in imported equipment.

Imported equipment can only slow the rate of decline in oil production once it begins. In large measure this reflects the deeply rooted nature of the oil problem. The forced-draft approach to achieving production targets, for example, has been expensive in terms of exploration and of recovery rates in producing fields. As a result, proved reserves have stagnated since the early 1970s, and no large finds have been made since the Samotlor

Note: This memorandum provides a supplemental analysis for the CIA publication *Prospects for Soviet Oil Production*, April 1977, Unclassified.

field was located in 1965. Only by working this field harder than any other major oilfield in the world have the Soviets been able to come close to their production targets.

At this point the Soviet Union has opted to continue its past approach. Any shift to exploration drilling would entail drilling fewer production wells and an immediate and sharp fall-off in current production. Indeed, the pressure to focus more heavily on development drilling will intensify because of the large capacity additions needed to offset depletion of old oil fields and to provide for planned increases in production. By the Soviets' own calculations, depletion offsets alone in 1976-80 will equal total capacity additions during 1971-75. To add the capacity needed to meet 1980 production goals, the Soviets will have to increase their rate of development drilling 50 percent between 1976 and 1980.

The Soviets are examining a variety of techniques to forestall the production decline. The prospects of such methods having more than an insignificant impact during the time period of our analysis are negligible, however. Soviet production practices make it difficult to implement tertiary recovery procedures, because their massive water flood techniques adversely affect oil-reservoir permeability. Given the widespread damage inflicted on major oil reservoirs, the Soviets will find it difficult to increase recovery rates more than a few percentage points over the long term with tertiary methods.

The difficulties the Soviets face on the oil front do not stem from any lack of resource commitment on their part. Indeed, measured by the resource cost in terms of material and manpower, the USSR may expend as much effort on producing oil as all Free World countries combined. Because of the low productivity of this effort, however, the results are only a fraction of those in the West. For example, US firms drilled five times as much meterage as did the Soviet Oil Ministry with about the same number of rigs. For 1976, the Soviet Oil Ministry required some 800,000 employees to produce 10.4 million b/d of oil.

Plans and Plan Fulfillment

From World War II until the early 1970s, the Soviet record in oil production was enviable. Plan production goals were consistently met or exceeded at only a small cost in additional effort. Production in 1970 was 350 million tons (7 million b/d), more than nine times the 38 million tons (760,000 b/d) output of 1950. This great increase in production was accomplished without anything like a commensurate increase in inputs. Over the 20-year period, the amount of drilling rose only about 210 percent and the number of rigs in active use only 57 percent, from 1,119 to 1,760.

This rapid growth in oil industry productivity was made possible only by the discovery of extremely rich and accessible oil deposits in the Urals-Volga region, where output grew from 5 million tons (100,000 b/d) in 1950 to 210 million tons (4.2 million b/d) in 1970. During 1937-55, the Soviets found and developed several of the world's largest and richest fields in this region. Two of them--Romashkino and Arlan--contained as much recoverable oil (19 billion barrels or 2.5 billion tons) as the combined total of the 10 largest fields ever discovered in the lower 48 states of the United States. At its peak in 1970, Romashkino produced 82 million tons (1.63 million b/d), 23 percent of total Soviet output in that year. Since that time, Romashkino's output has been maintained at about 80 million tons (1.6 million b/d).

Since the mid-1950s the size of discoveries in the Urals-Volga has fallen off sharply. Growth in output from this region slowed dramatically in the early 1970s, as all of the large fields found in the 1940s and 1950s had been fully developed.

During 1972-75 original output goals were not met. In 1975, despite the largest absolute annual increase in oil production (including gas condensate) ever achieved, total Soviet oil output fell short of the original target by about 14 million tons (280,000 b/d), or 2.8 percent. The average annual rate of growth rate in oil production planned for 1971-75 was 7.4 percent, but the actual growth rate was only 6.8 percent. The four-year trend of underfulfillment apparently continued in 1976 with a slight shortfall, although detailed data have not been reported.

During this period of oil production shortfalls, several of the older producing regions--the Ukraine, North Caucasus, and Azerbaydzhan--registered declines in output, and production in the Urals-Volga levelled off. Only by overfulfilling production goals in West Siberia was the USSR able to come close to the national targets during 1972-75. Original plans called for West Siberia to produce 120-125 million tons (2.4-2.5 million b/d) in 1975; actual output was 148 million tons, almost 3 million b/d.

A large share of the overfulfillment in West Siberia was provided by the rapid development of the Samotlor field. This giant field, roughly comparable in size to Romashkino, has accounted for 24-26 million tons (480,000-520,000 b/d) of the 30-million-ton-per-year (600,000 b/d) annual increase in national production during the past four years. In 1976, Samotlor produced 110 million tons (2.2 million b/d), nearly 35 percent more than Romashkino's greatest annual output. It is scheduled to peak at 130 million tons (2.6 million b/d) in 1977-78, and no new fields even remotely comparable in size have been discovered to maintain production increases.

USSR: Oil Production Plans and Fulfillment

	Crude Oil		Crude Oil and Gas Condensate	
	Million Tons	**Million b/d**	**Million Tons**	**Million b/d**
1971				
Plan	371	7.42	N.A.	N.A.
Actual	371.8	7.44	377.1	7.54
1972				
Plan	395	7.90	N.A.	N.A.
Actual	393.8	7.88	400.4	8.01
1973				
Plan	429	8.58	N.A.	N.A.
Actual	421.4	8.43	429.0	8.58
1974				
Plan	461	9.22	N.A.	N.A.
Actual	450.6	9.01	458.9	9.18
1975				
Plan	496	9.92	505	10.10
Actual	481.8	9.64	490.8	9.82
1976				
Plan	510.6	10.21	520.6	10.41
Actual	N.A.	N.A.	519.7	10.39
1977				
Plan	N.A.	N.A.	550	11.0
Projected			540-550	10.8-11.0
1980				
Plan	N.A.	N.A.	640	12.8
Projected			550-600	11-12

For the next decade at least, any growth in output, including that needed to offset declines in older fields (including Samotlor after 1980), must come from many smaller West Siberian fields.

The 1976-80 plan, as originally proposed, called for oil production to reach 620-640 million tons (12.4-12.8 million b/d) in 1980. West Siberia's

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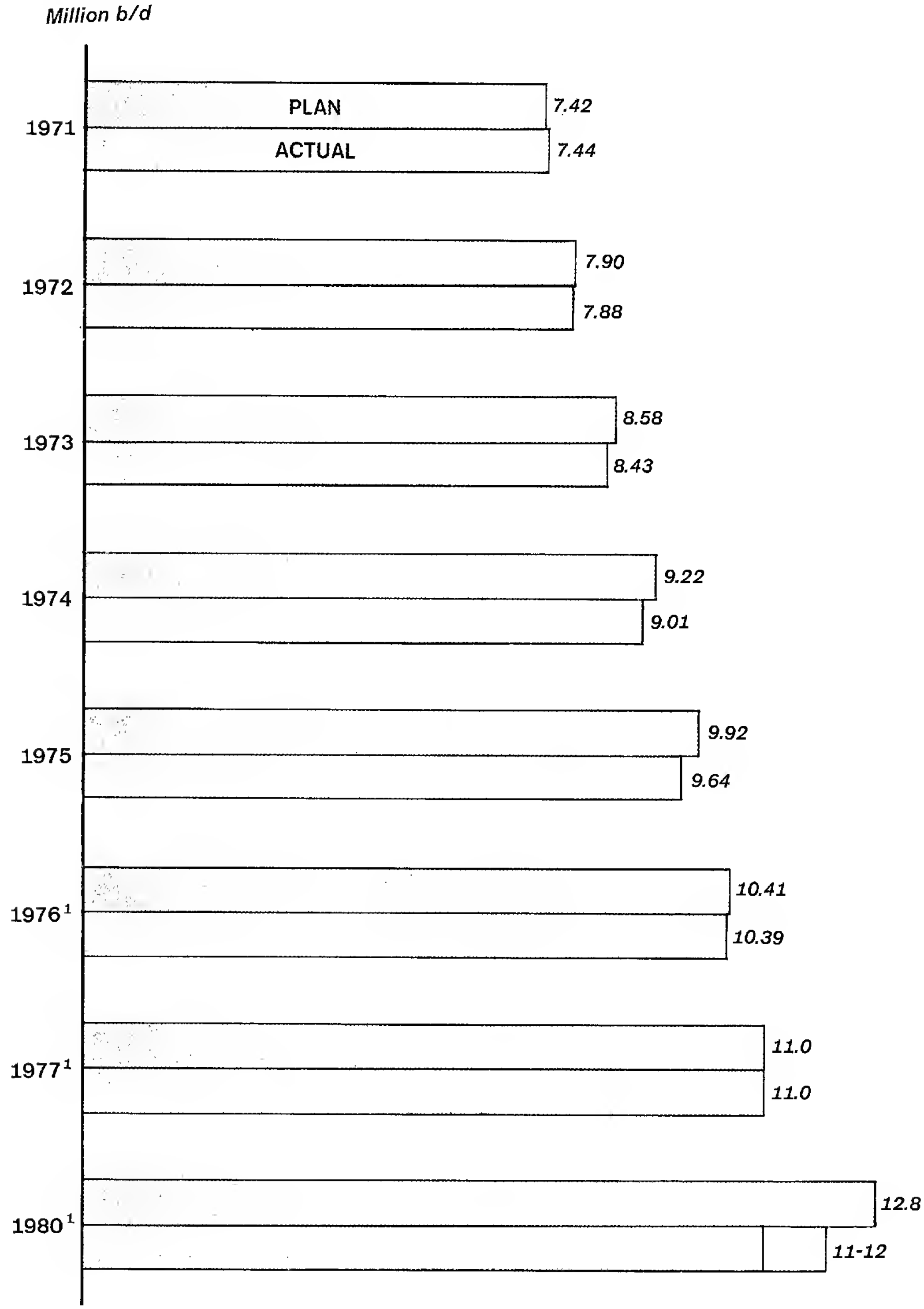
USSR: Oil Production Plans and Fulfillment



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[1] Including gas condensate.

goal--300-310 million tons (6.0-6.2 million b/d)--is almost half of that for total national output in 1980. Despite increasingly apparent problems in the oil industry--oil fields approaching exhaustion, inadequate exploration drilling, no new giant discoveries since Samotlor in 1965, and growing need for modern Western exploration and production equipment and technology--the 1980 goal was cited as 640 million tons (12.8 million b/d) in October 1976 by the Deputy Chairman of the Council of Ministers.

Why this goal was set at the upper end of the original range, when the many difficulties confronting the industry would seem to dictate a lower figure, remains a mystery. Perhaps the hierarchy believes that the higher goal will spur the oil industry to greater efforts. At any rate, for the reasons stated in the discussion of regional production, it seems unlikely that the goal can be attained.

The Soviets recognize that long-range prospects for oil production have dimmed during the past decade. In 1967, Soviet sources projected oil production in the year 2000 at 1-1.15 billion tons (20-23 million b/d). In 1977, a high-level Soviet economist stated that projections for oil production at the end of the century have been scaled down to 800-900 million tons (16-18 million b/d). This reduction probably was prompted in part by a reassessment of available oil reserves and in part by difficult production and transport problems in the regions from which future production growth must come.

Oil Production and Development of Fields

Throughout its history the Soviet petroleum industry has depended heavily on a single region--in some cases on a single large field such as Romashkino or Samotlor--for growth in production. From World War II through 1970, the increase in Soviet oil output came first from the old fields around the Caspian Sea (near Baku in Azerbaydzhan SSR), and beginning in the 1950s, from large fields in the Tatar and Bashkir ASSRs and in Kuybyshev Oblast of the Urals-Volga region. Since 1970, nearly all output growth has come from West Siberia, primarily from the giant Samotlor field. Thus far, no new large successor has been found to ensure future growth.

The Impending Decline of the Urals-Volga

The Urals-Volga region still is the leading producer of oil in the USSR but will be surpassed by West Siberia in 1977 or 1978. In the mid-1960s the Urals-Volga accounted for about 70 percent of total Soviet oil output. Major fields in this region have been producing for more than 25 years and are rapidly approaching depletion.

USSR: Crude Oil[1] Production, by Region

Million barrels per day

Region	1965	1970	1971	1972	1973	1974	1975	1976[2]
Total USSR	**4.86**	**7.06**	**7.54**	**8.01**	**8.58**	**9.18**	**9.82**	**10.39**
Western region and Urals	4.51	5.80	5.90	5.97	5.98	5.97	6.00	5.89
Urals-Volga	3.48	4.17	4.23	4.31	4.40	4.44	4.50	4.48
Tatar	1.53	2.01	2.02	2.04	2.06	2.07	2.07	2.05
Bashkir	0.88	0.81	0.80	0.80	0.81	0.80	0.81	0.80
Kuybyshev	0.67	0.70	0.71	0.71	0.71	0.70	0.69	0.67
Perm'	0.20	0.32	0.34	0.36	0.39	0.41	0.44	0.46
Orenburg	0.05	0.15	0.17	0.19	0.21	0.23	0.24	0.25
Lower Volga	0.12	0.14	0.15	0.15	0.15	0.14	0.14	0.14
Udmurt	0	0.01	0.01	0.03	0.04	0.05	0.07	0.08
Saratov	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Komi	0.04	0.11	0.12	0.13	0.13	0.14	0.14	0.17
Belorussia	Negl	0.08	0.11	0.12	0.14	0.16	0.16	0.17
North Caucasus	0.41	0.68	0.72	0.69	0.59	0.53	0.47	0.40
Azerbaydzhan	0.43	0.40	0.38	0.37	0.36	0.36	0.34	0.33
Ukraine	0.15	0.27	0.28	0.28	0.27	0.25	0.23	0.23
Other[3]	Negl	0.09	0.06	0.07	0.09	0.09	0.16	0.11
Eastern region	0.35	1.26	1.64	2.04	2.60	3.21	3.82	4.50
West Siberia	0.02	0.63	0.90	1.25	1.75	2.33	2.96	3.63
Central Asia	0.28	0.58	0.66	0.71	0.76	0.79	0.81	0.80
Mangyshlak	0.04	0.21	0.26	0.30	0.34	0.38	0.40	0.40
Emba	Negl	0.05	0.06	0.06	0.06	0.07	0.07	0.07
Turkmen	0.19	0.29	0.31	0.32	0.32	0.31	0.31	0.30
Other	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sakhalin	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04
Other[3]	Negl	0.05	0.03	0.03	0.04	0.04	0.01	0.03

1. Including gas condensate.
2. Preliminary estimate.
3. Chiefly gas condensate produced by the Ministry of the Gas Industry.

Waterflooding has been used since the initiation of production in most of these fields--as is common practice in the USSR--to maintain and/or increase formation pressure and to increase well flows. In a number of fields, large volumes of water have been injected at high pressures, damaging reservoirs and reducing the amount of recoverable oil. In the mid-1960s the water cut in total fluid recovery began to rise substantially and use of pumps became necessary to increase fluid flow and to maintain oil output. In the late 1960s output began to decline in Bashkir and threatened

to do likewise in the other parts of the Urals-Volga. In 1971, however, the US removed trade controls on high-capacity submersible pumps, and since then the USSR has imported from US firms 1,000 pumps with a total fluid lifting capacity of more than 3 million b/d. These pumps stabilized oil production in the Urals-Volga, but, as the water cut in total fluid increases, oil production will decline unless there is a comparable increase in the capacity of fluid lifting equipment. Such an increase in lifting capacity seems unlikely, given competing demands on the limited capacity of equipment producers.

In some newer producing areas of the Urals-Volga, such as Orenburg and Udmurt, oil output will rise, but not nearly enough to offset the probable decline in the large, older fields. Optimistically, output in the three major producing areas of the Urals-Volga--Tatar, Bashkir, and Kuybyshev--will fall by only the 36 million tons (720,000 b/d) called for in the 1980 plan when compared with 1975. Depending upon how fast the water cut rises, Urals-Volga production in 1980 probably will range somewhere between 175 and 200 million tons (3.5 and 4 million b/d) compared with 225 million tons (4.5 million b/d) in 1975.

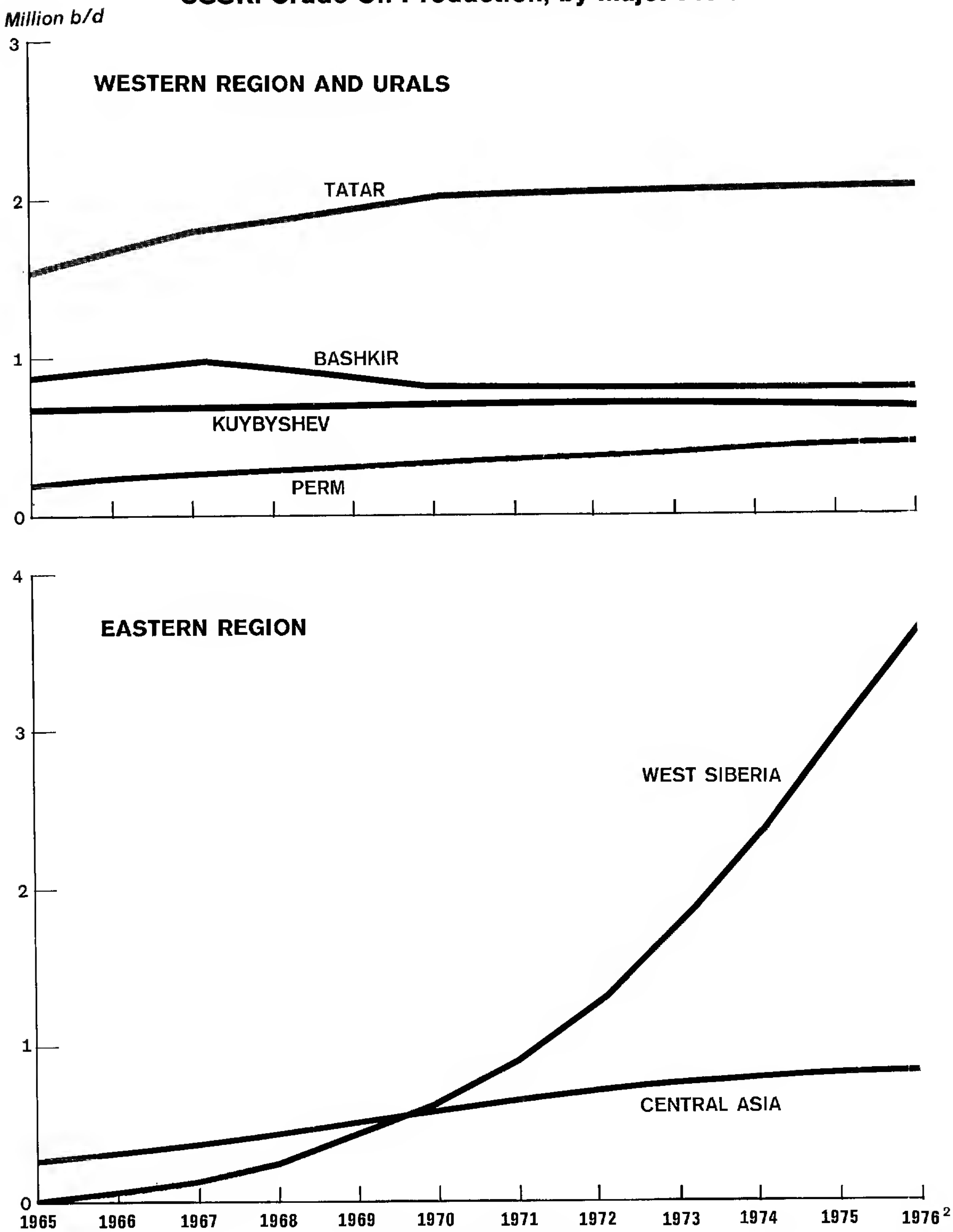
The Tatar SSR accounts for roughly half of the oil output of the Urals-Volga region. Despite the development of many small fields in the past decade, about 80 million tons (1.6 million b/d) of the total output of about 105 million tons (2.1 million b/d) comes from the supergiant Romashkino field. Water injection in this field has been increasing steadily, reaching a total of almost 150 million tons (3 million b/d) in 1975. As a result, the total volume of fluid that must be lifted to produce any given quantity of oil has also been increasing. The average oil output per producing well declined from almost 23,000 tons (460 b/d) in 1970 to roughly 10,000 tons (208 b/d) in 1975. Over the past eight years production from the field has been maintained at a constant level by in-fill drilling and narrow spacing of producing and injection wells combined with the use of surfactants and other chemicals in conjunction with waterflooding.

The Rise of West Siberia

Since the early 1970s the bulk of the increase in crude oil production has come from West Siberia, where commercial output began in 1964. Sizable production increases were expected from the oilfields in the Mangyshlak Peninsula in western Kazakhstan, but output there has not risen nearly as fast as anticipated because of improper waterflooding procedures and complicated drilling problems.

West Siberia is crucial to the Soviet effort to continue raising oil output. All of the increase in Soviet production planned for 1980 is to come from West Siberia, where output is to rise from almost 150 million

USSR: Crude Oil Production[1] by Major Field



[1] Including gas condensate.

[2] Estimated.

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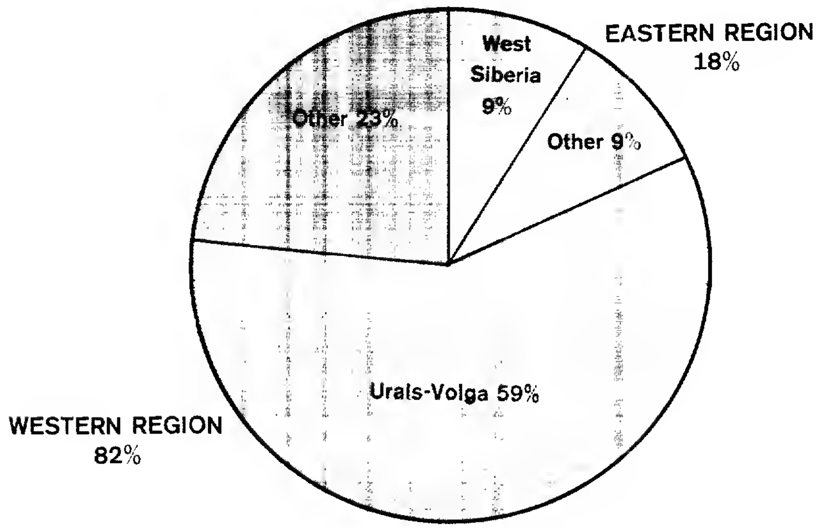
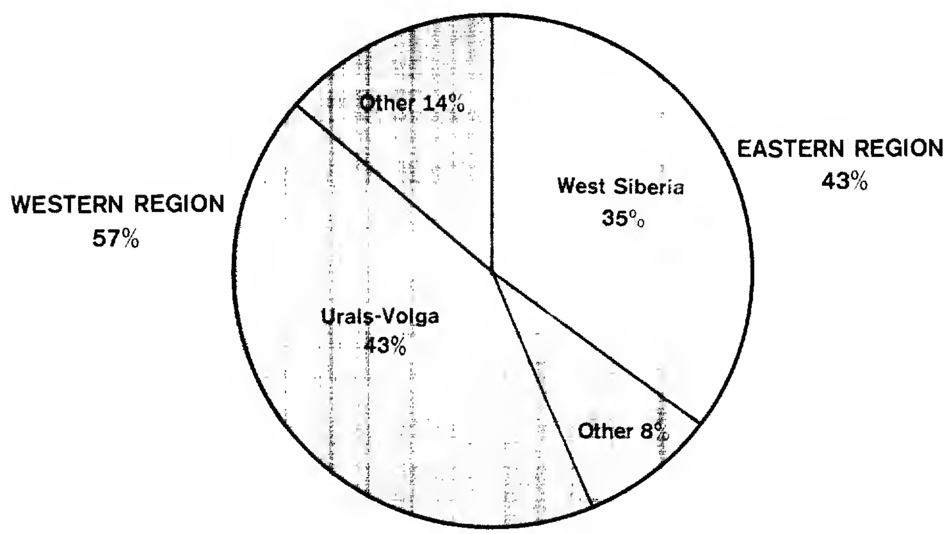
USSR: Distribution of Crude Oil Production[1]

1970



7.06 Million b/d

1976



10.39 million b/d

[1] Including gas condensate.

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tons (3 million b/d) in 1975 to 300-310 million tons (6.0-6.2 million b/d) in 1980. This goal is considerably higher than an earlier target of 230-260 million tons (4.6-5.2 million b/d). During 1977-80, increases in oil production will depend on rapidly developing many smaller new fields while maintaining peak output at the Samotlor field. Available Soviet data on West Siberian oilfields scheduled for production by 1980 indicate that maximum regional production would approximate 290 million tons to (5.8 million b/d) if all fields were to reach their maximums at the same time. However, some of West Siberian fields have already peaked and are now on the decline; others will peak before or after 1980. The Shaim fields, which began production in 1964, are well past their peak and have water cuts exceeding 50 percent. Ust-Balyk, the second largest West Siberian field, is also declining, but development of a new producing zone may prolong its life.

Although new fields are being discovered in West Siberia, no giant fields have been found comparable to Samotlor, which has a production capacity of about 130 million tons (2.6 million b/d) that probably will be reached in 1977-78. Present development plans call for Samotlor to maintain maximum output for four years. These plans, however, depend on the use of high-capacity submersible pumps and on drilling a large number of additional wells to maintain production at its maximum.

In general, West Siberian fields appear to respond poorly to production techniques that worked well in the Urals-Volga region. At Romashkino, it took 18 years before the water cut rose to 10 percent; at Samotlor this share of water in total fluid produced was reached in about 3 years. In the Urals-Volga, submersible pumps last up to a year without service; at Samotlor, because of silt and salt in the oil and water, they must be replaced after only 60 days of operation. In recent months the USSR has begun to negotiate with US and other Western firms to undertake an extensive gas-lift program to cope with rising fluid lifting requirements and to extend the producing life of the Samotlor field.

The ambitious plans for West Siberia in 1980 do not appear attainable because of the extensive drilling that will be required--30 million meters during 1976-80 compared with 9.5 million in 1971-75--and the need to place six to eight new oil deposits in production each year of the current five-year plan. West Siberian oil production in 1980 is more likely to be on the order of 250-260 million tons (5.0 to 5.2 million b/d) rather than the 300-310 million tons (6.0-6.2 million b/d) planned.

Frontier Zones for Oil Production

Geological conditions favorable to large future discoveries of oil exist over much of the Arctic offshore regions (Barents, Kara, East Siberian, and

Chukchi Sea basins), in the East Siberian lowlands, in deep structures in the Caspian Sea, and perhaps off Kamchatka and Sakhalin in the Sea of Okhotsk. Production from most of these areas, however, is at least a decade away. The technology to cope with pack ice such as will be encountered in the offshore Arctic seas has not been developed as yet, even in the West. Thus, development of these areas is unlikely before the end of the 1980s at the earliest.

Operating conditions are more favorable in the East Siberian lowlands than in Arctic offshore areas, but the severe climate, extensive permafrost, great distance from energy consuming centers in the western USSR, and difficult transport problems will restrict the pace of development when oil is found. To date no commercial-scale discoveries of oil have been made.

In the offshore area around Sakhalin, Japanese firms are working on a cooperative venture with the Soviets to explore for and develop oil deposits. The exploration program is at least one year behind schedule, and potential oil production does not appear to be as promising as the Soviets originally estimated. Weather and ice conditions in this area are harsher than in the North Sea, where development of commercial-scale production took about 10 years. Significant production from the Sakhalin area is unlikely before the mid-1980s.

Soviet Production Methods

Over the past 20 years the Soviet Union has consistently claimed that, because of advanced practices, it recovers a much higher percentage of the original oil in place than does the United States or other Western oil producing countries. The Soviets attribute their high recovery rates to their production practices, especially the early employment of high-pressure water injection. Now that many of the Soviet fields have been in production for 20 years or more, it is becoming apparent to them that recovery will be much less than originally estimated. In the Urals-Volga area, for example, Soviet engineers cut their recovery estimates from 51 percent in 1960 to 44 percent in 1970. Further revisions downward probably will be made.

Water-Injection Pressure Maintenance

The most important Soviet oil production technique in recent years has been the widespread use of water injection to maintain a rapid flow of oil through the reservoir to the producing wells. Since World War II, the Soviets have begun water injection in new fields soon after oil production starts and continue the practice throughout the life of these fields. Water-injected fields accounted for more than half the oil produced in the USSR as early as 1955, more than 66 percent in 1960, and more than 80 percent in 1976.

The water-injection program has enabled the Soviets to minimize their initial oil field investment. By using forced water injection they can obtain a much higher initial level of output per well than would be possible under Western practice. The higher output per well means that, at least initially, the Soviets need fewer producing wells to achieve a given level of output. In some fields the Soviets have used water flooding to raise the pressure in the reservoir enough to make the oil flow to the surface when it otherwise would not. This practice also temporarily eliminates the need for costly pumping equipment.

While these practices yield high production rates in the early years of an oil field's life, problems develop as the fields age. Injected water breaks through the oil-bearing formations into the producing wells. When this happens, additional wells must be drilled (in-fill drilling) to locate the oil, or expensive pumps must be installed to lift the large volumes of fluid (water and oil) needed to maintain oil production.

Soviet reservoir engineers first used this approach to waterflooding in 1948 at Tuimazy in the Bashkir ASSR. Water was injected not only along the edges of the oil pool but also through interior rows of injector wells that paralleled and crisscrossed the field. Since 1967, a thin network of wells located on 100 hectare blocks has been used for most new field development. The water volumes injected often exceed the void space of the oil produced, and the injection pressures raise normal formation pressures.

In recent years, submersible (Reda-type) centrifugal high-volume pumps have been used to maintain the oil flow from water-injected fields. Although oil is quickly removed from highly permeable rock as the waterflood sweeps through, considerable amounts of oil are left behind in less permeable "pillars." The use of submersible pumps combined with water injection eventually causes coning, i.e., fingers of water break through to the producing wells, bypassing much oil.

When the water cut of the fluid produced from the original network of wells becomes excessive, the field usually has to be redrilled. Smaller well spacing patterns of 50 hectares, 25 hectares, 12 hectares, and six hectares are used for each successive development stage. The Romashkino field has been redrilled four times, and in each phase a smaller well spacing pattern was used to capture the bypassed oil.

The total impact of these practices on oil recovery in the larger Urals-Volga and West Siberian fields before 1974 cannot be fully assessed because of limited data. In 1974, however, several prominent Soviet leaders and reservoir experts admitted that many mistakes were made at Tuimazy

and at numerous other fields where the same exploitation methods were applied. These fields were not uniform in terms of porosity, permeability, and rock composition, and the Soviet engineers were late to recognize the importance of these factors in designing waterflood operations. As a consequence much oil has been lost. Soviet methods definitely led to premature coning and water break-throughs at Samotlor in 1972 and at six or seven other large West Siberian fields. How much of the decline in expected recovery rates stems from this kind of damage is uncertain; the original estimates for recovery appeared overly optimistic even with ideal reservoir management.

Failure to treat ground water and surface water used in most waterflood projects has also created reservoir problems. Bottom-hole temperatures and the oil recovery factors were lowered by injecting cold surface water into the Uzen-Zhetibay reservoirs of the Mangyshlak Peninsula, as well as those at Samotlor and Ust Balyk in West Siberia. Injection of untreated water has led to excessive salt formation in well bores and downhole pumping equipment in West Siberia. Organic material and dissolved gases in untreated surface waters injected into hot oil reservoirs has also caused prolific bacteria growth that reduces rock porosity.

Oil Recovery

In the 1950s and early 1960s, Soviet engineers believed that their practices would result in much higher recovery rates than were prevalent in the West. As late as 1960 they still believed that they would recover nearly 50 percent of the original oil in place in the Urals-Volga region. These beliefs are now in question.

The average rate of recovery in the US remains at 32-33 percent, despite great improvements in technology and equipment in recent years. Soviet planners apparently began to question planned recovery factors after the Oil Ministry requested increased imports of US technology and equipment after 1971.

In 1974, N. K. Baibakov, V. D. Shashin, A. P. Krilov, and other ranking officials spoke out on the oil recovery problem underscoring that "it lies at the heart of the reserve issue." A Soviet study on changing oil recovery rates for $A+B+C_1$ reserves in 1960-70 noted that the average annual rate of decline in the expected recovery factor was four-tenths of a percentage point during 1960-65, but it increased sharply to nine-tenths of a percentage point during 1966-70. The Soviets now admit that many large fields, including Samotlor, will not reach their planned recovery rates.

Some Soviet analysts ascribe the problems to a poor understanding of the reservoirs at the time development plans are made. Poor seismic and well-logging equipment often prohibits the collection of good data. Similarly, the amount of damage from water breakthroughs in the largest reservoirs is not known precisely even by the Soviets; scattered published data suggest that they perceive the problem to be very widespread and increasing. Water production accounted for almost 50 percent of total fluid output in 1975, according to several Soviet sources.

A. P. Krilov stated in 1974 that extension of the basic development plan pioneered at Tuimazy in 1948 to other fields was affecting these deposits in the later stages of their development. Several problems experienced at Tuimazy reoccurred at Romashkino, which is now producing 55.5 percent water, as well as at several Kuybyshev and West Siberian fields. Tuimazy is now producing 86 percent water from the main Devonian zones. According to the originator of the development plan, Tuimazy was not developed in the best possible way.

Another Soviet expert raised the point that 1970 crude oil production of 348 million tons (7 million b/d) was accompanied by 273 million tons of water (5 million b/d)--i.e., a 43 percent water cut. By 1974, the nationwide average water cut exceeded 47.3 percent, and the water ratio is expected to increase rapidly due to the age of most of the largest fields. Other experts indicate that water breakthrough between the seventh and 11th years of oil production increases the water cut from 15 percent to 30 percent at younger deposits. These observations were probably based on experience in West Siberia. Other sources note that the Shaim deposits, with stable oil production of 5.6 million tons annually (110,000 b/d) since 1972, were 46 percent water cut after 9 years of exploitation.

A 1972 study of 102 wells in certain Samotlor zones showed water cuts of 12 to 14 percent; the water production was attributed to coning and not to bad cement jobs as had been suspected. Water appeared in oil production soon after waterflooding began at the Shaim, Surgut, and Nizhnevartovsk fields of West Siberia–the only major fields opened since 1965.

A table in a Soviet study notes water produced in all the major producing regions of the USSR in 1961 and 1965.

USSR: Regional Production of Water as a Percent of Liquids Recovered

Region	1961	1965
Urals-Volga	11.5	24.0
Trans Caucasus	77.0	75.0
North Caucasus	56.4	48.8
Ukraine	17.5	12.0
Central Asia and Kazakhstan	73.8	77.2
Average (presumably weighted)	**43.0**	**44.0**

More recent statements of the water problem appeared in 1974-75 with water production estimated at 43.8 percent in 1970, 47.3 percent in 1974, and 46.4 percent in 1975. These statements appear inconsistent with the earlier data. The age of the fields, the advanced state of depletion, and Soviet studies indicating that 80 percent of the oil is recovered in 18 years at the larger Urals-Volga fields suggest that the water problem is much greater than the above figures indicate.

The Soviets are receiving temporary relief by redrilling most fields two to four times using closer well spacing. Since new wells initially produce largely oil, this has the effect of reducing the average water cut for the entire field. For example, at Romashkino, the central sector of the field produced 80 percent water in 1968-69. Altogether Romashkino has been redrilled four times, which reduced the water cut to as low as 48 percent in the early 1970s. The average water cut, however, is once again rising, reaching approximately 55 percent in 1976.

Fluid Production and Pumping Requirements

Realization of 1980 production goals of 300-310 million tons (6-6.2 million b/d) in West Siberia is critical to meeting the national target of 640 million tons (12.8 million b/d). Nationwide, the production of water was roughly equal to total oil recovery in 1975. In-fill drilling both at the old depleted fields of the Urals-Volga and at the newer West Siberian fields is requiring an increasing share of the total Soviet drilling effort. In 1976, 10 million meters of the 12 million drilled by the Soviet Oil Ministry were allocated to development wells. Limitation on the Soviet ability to drill new wells means that total fluid lifting requirements will nearly double over the current five-year plan. Producing anything near 600 million tons

(12 million b/d) of oil in 1980 with only a 3 percentage point annual increase in the water ratio implies an annual increment approaching 200 million tons (4 million b/d) of fluid in absolute terms in 1976-80. With a 6 percentage point rise, annual increments in fluid lifting would reach roughly 400 million tons (8 million b/d).

The primary Soviet strategy for dealing with increasing water cuts is the use of electric submersible pumps. The total Soviet inventory of these pumps on 1 January 1975 was 11,950, of which 8,700 were in service and the remainder were undergoing repair or in reserve. These pumps accounted for 200 million tons (4 million b/d) or nearly 40 percent of total oil output in 1976. To meet plan goals for output in the Urals-Volga, a great increase in the number of pumps will be required. A recent article said that 470-500 new pumps would be needed each year in Bashkir ASSR just to stabilize output.

USSR: Planned Crude Oil Production and Estimated Total Fluid Output

	Oil		Water		Total Fluid	
	Million Tons	Million b/d	Million Tons	Million b/d	Million Tons	Million b/d
Case A						
1975	491	9.8	491	9.8	982	19.6
1976	520	10.4	586	11.7	1,106	22.1
1977	550	11.0	700	14.0	1,250	25.0
1978	580	11.6	834	16.7	1,414	28.3
1979	610	12.2	995	19.9	1,605	32.1
1980	640	12.8	1,188	23.8	1,828	36.6
Case B						
1975	491	9.8	491	9.8	982	19.6
1976	520	10.4	662	13.2	1,182	23.6
1977	550	11.0	897	17.9	1,447	28.9
1978	580	11.6	1,233	24.7	1,813	36.3
1979	610	12.2	1,736	34.7	2,346	46.9
1980	640	12.8	2,560	51.2	3,200	64.0

Case A assumes 50 percent oil and 50 percent water in 1975 and water cut increases 3 percentage points annually.

Case B assumes 50 percent oil and 50 percent water in 1975 and water cut increases 6 percentage points annually.

In May 1975, the Soviets noted that electric submersible downhole pumps provided the chief means of automating oil production at Samotlor. This article also made reference to the use of imported high-volume US-made Reda and BJ pumps, which lift up to 1,000 tons (7,300 barrels) of fluid per day. About 1,025 US pumps have been delivered and about 1,210 will have been shipped by yearend 1977, on the basis of present orders. Approximately 2,000 of these pumps are made each year in the West, all in the US, and delivery to the USSR presently is restricted to about 30 pumps per month because of limited capacity, backorders, and long lead times. Present Soviet-made submersible pumps have lower capacities and require more maintenance than their US counterparts.

Soviet reports indicate that the operating life of many of the Reda type pumps now in use at Samotlor is as short as 60 to 90 days. The high maintenance required on pumps used at Samotlor is due to the presence of fine silt and sand grains in the oil, salt formation on the pumps, lack of heat-resistant electric cable, and frequent power outages that burn out the motors.

Last year, the Oil Ministry, in a major change in production policy, decided to adopt gas-lift development at Samotlor and Federovo at a cost of $600 million to $1.1 billion. Excessive maintenance costs may have prompted the Soviets to acquire US gas-lift equipment as a substitute for electric downhole pumps. Gas-lift units are cheaper to operate and much easier to maintain with wire line tools from the surface. This is the largest project of its kind in the world to date. Long lead times are expected, however, before delivery can be made.

New Capacity and Drilling Requirements

To meet planned production targets the Soviet oil industry will have to increase productive capacity sharply in the years ahead. Large capacity additions will be needed to offset the sharply declining productivity of existing wells. Still more new wells will be needed to provide for growth in output. To achieve the necessary capacity additions, maintain maximum output from existing fields, and discover and prove up new reserves will require a massive increase in the Soviet drilling effort. Whether the industry can meet these requirements is far from certain, given the present level of Soviet drilling technology and practice.

Capacity Requirements

The major element causing the sharp rise in new capacity requirements is the extremely rapid increase in new capacity needed to offset depletion in older areas. During 1961-65, for example, the USSR required only 68 million tons (1.4 million b/d) of new capacity to offset depletion; by

1971-75 they required nearly 260 million tons (5.2 million b/d). The plan for 1976-80 anticipates that as much as 390-400 million tons (7.8-8 million b/d) of new capacity will be required just for depletion offset. Developments in Bashkir ASSR highlight the nature of the offset problem. The 1976-80 plan anticipates some decline in Bashkir output, currently 40 million tons per year (800,000 b/d), and to moderate this decline the Baskhir Oil Trust believes that it will need to add new capacity at the rate of 10-12 million tons per year (200,000-240,000 b/d) during 1976-80.

Tatar ASSR, the largest oil producing region in the Urals-Volga, faces a situation similar to that of Bashkir. In Tatar, during 1966-70, new capacity was added at the rate of 10-12 million tons annually (200,000-240,000 b/d), and about half of the new capacity resulted in increased output. During 1971-75, Tatar added new capacity at the rate of 13-14 million tons per year (260,000-280,000 b/d), but all of this new capacity went to offset the depletion of old capacity. In 1976 output declined in Tatar for the first time since production began. A simple extrapolation of trends over the past 10 years suggests that capacity in Tatar will be depleted at the rate of about 20 million tons per year (400,000 b/d) during the 1976-80 period.

The situation in Kuybyshev is quite similar. The problem of achieving new capacity additions in all of these Urals-Volga regions is compounded because the water cut is rising at an extremely rapid rate and the need for lifting equipment is becoming critical. In a recent Pravda article the Bashkir Oil Trust said that "simply to maintain a high level of output," it will be necessary to install 470-500 submersible pumps each year in Bashkir alone. Without the pumps the drilling requirements for new capacity would be much higher.

The sharp rise in the rate of capacity depletion has caught the USSR by surprise, probably because of the unrealistically high oil recovery rates they anticipated at older fields. In 1970, when the 1975 plan goals were first announced, the Oil Ministry expected that only about 160 million tons (3.2 million b/d) of new capacity would be required to offset depletion during 1971-75. As the plan period progressed, they were forced to revise this estimate four times, and by the time the plan was completed, 258 million tons (5.2 million b/d) of new capacity had been required to offset depletion. Although actual new capacity additions far exceeded originally planned levels (392 million tons vs 300 million tons or 7.8 million b/d vs 6 million b/d), production fell 14 million tons (280,000 b/d) short of the goal. The same thing appears to be happening now. In 1975, the Soviet Oil Minister announced that 450 million tons (9 million b/d) of new capacity would be needed during 1976-80 to produce 620-640 million tons

(12.4-12.8 million b/d) of output. By mid-1976, this goal was revised upward to 530-540 million tons (10.6-10.8 million b/d).

Although the USSR added more than 390 million tons (7.8 million b/d) of new capacity during the 1971-75 period, it still fell short of its original production goals. The shortfall was minimized thanks to the giant new Samotlor field, where the Soviets were able to add more than 80 million tons (1.6 million b/d) of new capacity. In doing so, however, they pushed the field much harder and faster than originally planned. As late as 1973, planned peak output at Samotlor had been only 100 million tons (2 million b/d). Now the planned peak is to be reached in 1977/78 at 130 million tons (2.6 million b/d). In any event, 60 percent of the increase in total Soviet oil output of 138 million tons (2.8 million b/d) during 1971-75 came from Samotlor.

During 1976-80 Samotlor will provide a production increase of only about 43 million tons (860,000 b/d), if it reaches output of 130 million tons (2.6 million b/d) this year. To maintain Samotlor production at this level, however, the USSR will have to greatly increase its drilling effort there to offset the rapid rate of well depletion. Viewed in this way, every new well at Samotlor after this year will be for depletion offset. During 1976-80 the Soviets will have to add new wells at a much higher rate (about 500 per year compared with 250 annually in 1970-75). Beyond 1980, output at Samotlor will begin to decline despite increasing additions of new capacity.

After 1977 all growth in Soviet output will have to come from a number of much smaller fields in West Siberia, where well productivity rates are lower than at Samotlor and where the task of providing infrastructure will be much more difficult. If Soviet engineers attempt to meet 1978 plan goals by pushing Samotlor's output higher than the presently planned peak of 130 million tons (2.6 million b/d), production from this field will almost certainly begin to slump before 1980. As it is, Samotlor output this year will be 60 percent higher than the peak rate achieved at Romashkino--a similar-sized field--where peak output levels were maintained for nine years--1967 through 1975.

Drilling Requirements Escalate

The Soviet Oil Ministry is faced with steadily rising drilling requirements. The dual needs of finding new reserves and adding new producing capacity at existing fields to sustain planned rates of output growth have strained drilling capacity since the mid-1960s. Depletion of existing reserves meant that more and more rigs had to be allocated to development drilling so that new wells in old fields could help compensate for declining output per well. During this period, exploratory drilling

stagnated. Now, not only are development drilling requirements continuing to rise rapidly, but exploratory drilling must be increased sharply to locate and prove up reserves to support production in the 1980s. By that time, output in the old Urals-Volga fields will be falling rapidly, and production at Samotlor and other major West Siberian fields will have begun to decline.

At the same time, however, the limitations of Soviet drilling equipment are becoming increasingly apparent. As long as most Soviet drilling was at shallow depths, evolutionary improvements in turbo-drill design allowed steady improvements in rig productivity. Between 1946 and 1960, when most exploration was occurring in the Urals-Volga regions, exploratory rigs were able to improve their monthly average drilling speeds from less than 180 meters per rig per month in 1946 to 400 in 1960. In development drilling they did still better, going from 370 meters per rig per month in 1946 to more than 1,100 by the late 1960s.

With the move to West Siberia and the need to drill to greater depths in nearly all regions in the USSR, commercial drilling speed of exploratory rigs has fallen by 15 percent since 1960. The same indicator for rigs engaged in shallower development drilling has continued to rise, however. The Soviets have been working on improved versions of the turbo-drill that they claim will allow them to drill efficiently at depths of up to 3,500 meters. We doubt that this can be done unless the Soviets can make a quantum improvement in the quality of their drilling bits and of the steel used for rigs and drill pipe.

Because of the decline in rig productivity, the USSR will have to boost its active rig park to meet future drilling needs. In fact, the decline in the rig productivity should accelerate as a larger and larger share of total drilling takes place in Siberia, where wells are substantially deeper than in the old Urals-Volga fields and rig transport between wells is more costly and time consuming.

No evidence is available, however, to show that the Soviets have planned for or have the capacity to sharply boost their rig supply. As late as 1976, Oil Minister Shashin said that, to meet 1980 plan goals, rig productivity would have to rise by 42 percent during the plan period. Given recent trends, this task appears to be nearly impossible. Even if the USSR decided to massively reequip its drilling sector with Western equipment, adequate supplies would not be available for many years, in part because of order backlogs by Western buyers.

Selected Data on Soviet Drilling Activity

	1946	1950	1955	1960	1965	1970	1975
				Thousand			
Meters drilled[1]	1,003	3,534	4,763	6,740	9,261	10,972	15,116
Exploratory	383	1,449	2,540	3,200	4,752	4,604	5,418
Development	620	2,085	2,223	3,540	4,509	6,368	9,698
				Number			
Wells completed	950	2,893	3,320	3,892	4,903	5,311	6,062[2]
Exploratory	342	1,074	1,394	1,660	2,165	1,711	1,935[2]
Development (including water injection wells)	608	1,819	1,926	2,232	2,738	3,600	4,127[2]
				Meters			
Average well depth							
Exploratory	1,120	1,349	1,822	1,928	2,195	2,691	2,800[2]
Development	1,020	1,146	1,154	1,586	1,647	1,769	2,350[2]
				Rubles per Meter			
Average cost							
Exploratory	87.6	118.2	124.0	111.9	148.7	238.8	280[3]
Development	47.7	45.6	48.5	49.4	65.5	84.5	100[3]
				Units			
Number of rigs operating	430	1,119	852	1,130	1,624	1,760	1,800[3]
				Meters per Rig per Month			
Commercial drilling speed							
Exploratory	177	209	306	401	377	337	340[2]
Development	372	629	893	993	1,090	1,154	1,450[2]

1. These figures include drilling of all types: oil, gas, core holes (possibly for other minerals), and slim-hole stratigraphic tests by the Geology Ministry.
2. Estimated, based on 1974 data.
3. Estimated.

Drilling Plans

The Soviets plan to increase total drilling (presumably by the Oil Ministry) to 75 million meters in 1976-80.* Drilling in West Siberia is to increase from 9.5 million meters in 1971-75 to 30 million in 1976-80, a formidable undertaking. The Oil Ministry drilled 52 million meters of exploratory and development drilling in 1971-75, compared with a plan goal of 56 million. Drilling by the Oil Ministry in 1976 totaled 12 million meters; only 2 million were for exploration, while 10 million went for development.

Drilling of more than 70 million meters in each five year plan since 1965 has been considered essential by planners, but this goal has never been realized, mainly because of the failure of rig productivity to reach planned levels. Plans for 1976-80 call for 30,000 well completions, compared with 20,000 or so completions in 1971-75 and about 80,000 total well completions since 1950.

Goals of the Soviets for total drilling and well completion can be achieved only if they devote an even larger share of their drilling effort to development drilling. Rigs engaged in development drilling are roughly four times as productive as those used for exploration since depths are less, less time is spent moving between locations, and support infrastructure is better. If this shift continues, they may come closer to meeting plan goals during 1977-80, but they will pay a high price in the early 1980s. Meeting for both exploratory and development drilling goals would require increasing the number of active rigs by nearly 50 percent.

Exploratory Drilling

To replace reserves scheduled to be produced during 1976-80, the Soviets must find 21 billion barrels (2.9 billion tons), an amount that exceeds estimated gross discoveries during 1971-75 by roughly 50 percent. If production is to go on rising during the early 1980s, still more reserves will have to be located and proved up. The Soviets must find the equivalent of a new Samotlor or Prudhoe Bay field every two years or so.

Development Drilling

Soviet plans for 1976-80 call for 30,000 new producing well completions nationwide. During 1976, the Oil Ministry completed 4,800 wells and added a reported 87 million tons (1.7 million b/d) of new capacity. If the goal for new wells is to be reached, completions will have to average 6,300 per year during 1977-80 despite the increasing depth of the wells.

*In 1971-75, drilling of all types totaled 68 million meters. This figure includes both oil and gas wells, as well as core drilling for other types of minerals and slim-hole stratigraphic testing by the Geology Ministry.

The meterage drilled for development wells will have to rise by at least 50 percent--to 15 million meters–to reach this goal by 1980. Average new development well depths now run 2,350 meters; 30,000 well completions would require 70 million meters of development drilling even if all wells were successful. Given a success rate of about 90 percent, development drilling alone would require nearly all of the drilling called for in the plan.

Soviet Oil Equipment Supplies

The Soviet effort to find and produce oil is already enormous. In terms of material and manpower, the USSR probably expends as much or more effort on producing drilling rigs, bits, and associated equipment than do all the Free World countries combined. However, because of inferior quality and design, the productivity of most Soviet equipment is quite low, and the results obtained are only a fraction of those of the West. As a consequence, imports of Western technology and equipment are becoming increasingly necessary for the industry's growth. For the foreseeable future, the USSR will have to rely on the West for much of the equipment and know-how to realize its oil production potential, especially as exploration and development requires deeper drilling or takes place offshore, in East Siberia, or in the Arctic regions.

Soviet Oil Equipment

During most of the post war period the Soviet oilfield equipment industry produced a range of equipment and supplies that allowed rapid gains in oil output. The Soviet success was due in large part to the fact that oil operations centered on development of large fields in the Urals-Volga region where relatively shallow (2,000 meters or less) hard-rock formations exist. Under these conditions Soviet turbo-drills worked reasonably well, and most other equipment needs were met without great difficulty. This situation persisted until the late 1960s. Since then, however, severe weaknesses in the quality of Soviet oil equipment have become obvious as exploration and development in other areas have taken place.

Manufacture of petroleum equipment in the USSR is concentrated in some 40 plants under the All-Union Ministry of Chemical and Petroleum Machine Building. At least one-third of the plants are located in the Azerbaydzhan SSR near Baku, and they produce about two-thirds of all Soviet oil and gas production equipment. In recent years equipment manufacturers have been unable to keep pace with requirements, and the situation is getting worse as oil production shifts to remote and physically inhospitable regions where specialized equipment and technology are required. Soviet officials have indicated that, without greater domestic capacity to manufacture petroleum equipment, the 1980 oil production goal cannot be met.

Exploration Equipment

Frequent complaints appear in the Soviet prcss about the shortage of high-quality exploration equipment. Most Soviet seismic recording is still done on analog tape employing technology used in the US in the 1950s. Good quality seismic geophones and cables are in short supply. Because of the lack of good scismic data, the Soviets often cannot locate, identify, and map structures at depths greater than 2,000 meters. Moreover, because of poor recording data and a lack of digital processing units, mapping of complex traps--both structural and stratigraphic--is extremely difficult for Soviet geologists.

Drilling Equipment

The Soviets use three types of drilling equipment: turbo-drills, rotary drills, and electric drills. About 80 percent of Soviet drilling rigs are turbo rigs. The remainder are mostly rotary rigs roughly comparable with US equipment produced in the 1940s and early 1950s. The third type of rig, the electric drill, is essentially experimental. Although the Soviets have extensively tested electric drills, technical problems have not been solved. Despite the obvious shortage of drilling rigs, the Soviet rig park has remained essentially unchanged at 1,800 deep well rigs. Although the Soviets claim to produce up to 500 deep well rigs annually, this is inconsistent with their own rig inventory data.

The down-hole turbines used by Soviet turbo-drill rigs also have a relatively short life, typically only 600 hours. Because of the abrasion caused by drilling fluids, turbine vanes are quickly worn. Bearings also wear out rapidly from the harsh operating environment. Downhole turbines have three sections used singly or in combination depending on the depth, the type of material being drilled, and the required torque on the drill bit. In 1975 Soviet production of turbine sections was slightly less than 10,000, which implies that each operating rig requires reequiping with new turbines every six months.

Despite the demonstrated superiority of rotary drilling, the Soviets have basically stayed with the turbo-drill approach. There may be practical problems in making the shift in any case because rotary drilling would require large volumes of high-strength steel pipe. In using turbo-drilling, the Soviets are able to use their heavy-wall, poor quality drill pipe. Because of the weight of the drill pipe and turbine sections, Soviet rigs must be made much heavier than Western rigs. To reduce the weight of the drill strings and allow deeper drilling, aluminum alloy drill pipe, although three times as costly as steel pipe, is widely used in Soviet drilling operations.

The Kungur Engineering Works in the Urals manufactures about 80 percent of all the turbo-drills produced in the USSR. Soviet literature

indicates that a new turbo-drill has been produced that features a low speed and high torque rating. It includes a hydrodynamic jet braking system so that turbo-drill speeds can be controlled for optimum results under most drilling conditions. The Soviets claim that these improved turbo-drills can drill efficiently at depths up to 3,500 meters. Unless Soviet rock bit quality is greatly improved, however, this performance can not be readily achieved. Indeed, most drilling time in deep holes is spent removing the drill pipe in order to change bits, which last only a few hours. Soviet wells deeper than 3,000 meters usually take more than a year to drill.

Rock Bits

The USSR manufactures an estimated 1 million rock bits of all types annually, compared with only about 400,000 in the entire Western world. The quality of Soviet bits is grossly inferior to those produced in the United States. Soviet imports consist of high quality bits for deep drilling.

Pumps

The bulk of oilfield pumps are produced at petroleum machine building plants in the vicinity of Baku. Although data are not available on output of centrifugal, electric submersible pumps, the Soviets claim that about 11,000 such pumps are in operation in addition to those imported from the US. The Soviet units are inferior to US-manufactured pumps in efficiency, capacity, and service life. With the increasing volume of fluid to be lifted from waterflooded fields, the Soviets will require more high-capacity submersible pumps than they can produce and continued imports from the US appear to be a necessity.

Large-Diameter Pipe

Soviet capacity for manufacturing large-diameter pipe has not kept pace with demand. We estimate that during 1971-75 the USSR produced 11 million tons of large-diameter pipe (20 inches and larger), of which about 7 million tons were 40-inch diameter and larger. Total demand for large-diameter pipe during this period approximated 17 million tons, requiring 6 million tons of imports. Present plans call for construction of 36,500 kilometers of gas pipelines and 18,500 kilometers of oil pipelines during 1976-80. Pipe production capacity is scheduled to rise by at least one-third during the five-year period, but steel output is lagging and such a rise will be difficult. Even if production rises by the planned percentage, at least 4-5 million tons of pipe will have to be imported if the planned pipelines are to be completed.

Production of large-diameter pipe is concentrated in five major plants; the largest is at Chelyabinsk in the Urals. Most of the increase in pipeline production capacity is to come from two new plants. One is being built

at Vyksa in Gorkiy Oblast (Urals) to produce up to 2 million tons of pipe up to 48 inches in diameter. A second is to be constructed in West Siberia to produce pipe of 48-inch and 56-inch diameter.

Offshore Technology

The most obvious deficiency in Soviet equipment manufacture is the lack of modern offshore technology. Although the USSR has produced oil from offshore fields in the Caspian Sea for more than 20 years, most drilling and production has been conducted from man made islands or fixed trestles extending from the shore. At present the USSR has two modern and two obsolete jack-up drilling platforms, all operating in the Caspian Sea. Plans call for the number of mobile offshore platforms to reach 12 by 1980, including at least two semisubmersibles. It is doubtful that this goal can be reached; only three have been built in the past 10 years. The obsolete jack-ups--the Apsheron and the Azerbaydzhan--can drill to depths of 1,800 meters and 3,000 meters, respectively, in no more than 20 meters of water. The modern jack-ups include the Dutch-built Khazar and the Soviet-built Baky. Both rigs are rated for a maximum drilling depth of 6,000 meters in about 60 meters of water. A new rig, similar to the Baky, is being completed and should be ready for fitting out and testing this summer.

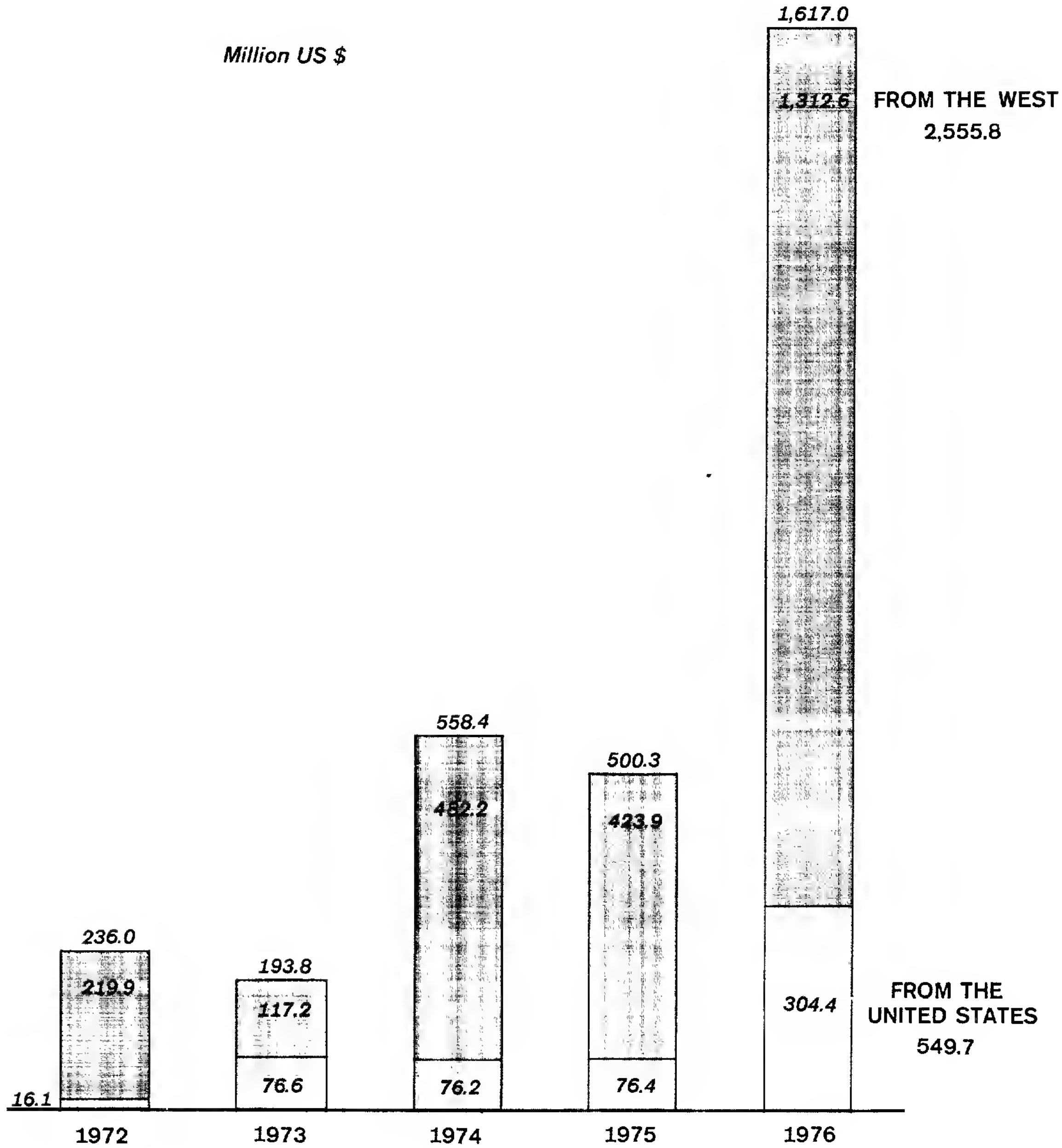
Imported Equipment

During 1972-76, Soviet orders of Western oil and gas equipment and technology (excluding large-diameter line pipe) totaled about $3.1 billion. The US domestic share was $550 million. US foreign subsidiaries provide a large share of the remainder. The bulk of the orders were for pipeline equipment, primarily for expansion of the gas pipeline network. Without these imports the rapid growth of Soviet gas production would not have been possible.

Soviet Orders from the US
1972-76

	Million US $
Total	**550**
Orenburg gas pipeline project	250
Other gas pipeline equipment	33
Submersible oil well pumps	148
Offshore equipment	40
Exploration and logging equipment	21
Oil pipeline equipment	21
Drilling equipment and drill bits	14
Refining equipment	9
Gas well completion equipment	8
Miscellaneous	6

USSR: Orders of Western Oil and Gas Equipment[1]



[1] Excludes imports of large-diameter line pipe, which totaled an additional $4 billion during 1972-76.

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Imports of high-capacity, submersible oil well pumps from the US also have been invaluable. During 1971-75, as the water cut in total fluid (oil and water) recovery rose primarily because of extensive waterflooding, these pumps increased fluid lift capacity to permit a rise in oil output of at least 1 million b/d. Other important orders from the US, Japan, and Western Europe include equipment for exploration, drilling, and refining.

The Soviets are aware that an extensive oil exploration program must be implemented in permafrost areas of East Siberia, in offshore areas of the Barents and Kara Seas, and in the deeper onshore formations of the Caspian depression. Since Soviet geophysical equipment is inadequate for this effort, seismic equipment and digital computerized recording units are being bought from the West. Offshore technology and equipment are also being sought in large amounts. Contracts have been placed with Western firms for facilities to manufacture offshore oil drilling equipment for use in deep water of the Caspian Sea, and negotiations are underway to buy semisubmersible offshore platforms, subsea production equipment, and drillships.

The largest order being negotiated at the present time is for gas-lift equipment to improve the efficiency of oil production at the Samotlor and Fedorov oilfields in West Siberia. This package, which is currently valued at about $1 billion, includes automated surface equipment for collecting gas and separating it from oil, compressors for pumping the gas back into oil wells, and downhole equipment for monitoring the flow of compressed gas at the bottom of the wells.

In addition to items already mentioned, the Soviet oil industry will need to import the following:

(1) Rotary rigs, drill pipe, and casing. The domestic supply of drill pipe and casing is not adequate in size, quantity, and quality required for field development, especially in cold climates and under difficult conditions. As the requirement to drill to greater depths increases, both onshore and offshore, the USSR will have to shift increasingly to rotary rigs and high-quality drill pipe, most of which will have to come from the West.

(2) Multiple completion equipment. As this type of equipment is relatively scarce in the USSR, in many fields separate holes must be drilled at a single site where separate producing zones exist. Multizone well completions permit important economies in reduced drilling costs and savings in casing.

(3) Secondary and tertiary recovery technology. The USSR is preparing to undertake a high-priority program to increase yields from

producing fields through intensive use of enhanced recovery techniques. Technical agreements have been signed with US oil companies to assist in this development. Soviet experience with enhanced recovery techniques is very limited, although every major secondary and tertiary method has been tried on an experimental or pilot plant basis.

Soviet Reserves of Crude Oil

The size of the USSR's reserves is uncertain because of definitional problems as well as secrecy. Our estimate is that current Soviet proved oil reserves are at the most 30-35 billion barrels (4.1-4.8 billion tons), roughly comparable with those of the United States. Soviet proved reserves have been relatively stagnant in recent years, and we see very little chance that enough new oil will be discovered during the next few years to appreciably improve the reserves-to-production ratio. Indeed, despite major efforts, it will probably deteriorate.

Approach to Estimating Soviet Reserves

The Soviet Union has not published an oil reserve estimate since 1938. In 1947 oil reserves officially became a state secret. Because of this secrecy, we have had to develop indirect methods, based on fragmentary data in the Soviet oil literature, for estimating Soviet reserves. Some insights into Soviet oil reserves can also be obtained from natural gas reserve data. Another technique is to determine Soviet oil reserves using the United States as an analogue.

Soviet literature provides two basic types of data that can be used to estimate crude oil reserves: the publication of periodic link relatives can be used to chain bits of information from the past to the present, and the reporting of ratios of reserves to production (R/P) will provide some information about reserves when production figures are known. As an example of the first type of reporting, one journal stated that explored reserves of oil increased 1.7 times in the past 10 years (1961-70). An example of the second type occurred when another journal reported that the R/P on 1 January 1968 had declined from more than a 28-year supply in 1966 to little more than an 18-year supply.

Reserve Definitions

An analysis of Soviet oil reserves is further complicated because, even in the historical literature (before World War II), the Soviet reserves were not comparable with those used in the West. Soviet definitions, unlike the US proved and probable reserves concept, do not specify that the reserves must be commercially exploitable with available technology and equipment.

The Soviets have defined several categories of oil reserves, A, B, C_1, C_2, D_1, and D_2. Soviet reserves in category A can usually be considered as reserves established through drilling, including undrilled areas enclosed by producing wells. Category B reserves include those in undrilled areas of a producing zone bounded by at least three producing wells but not completely enclosed. Category C_1 reserves are those with at least two wells in the producing zone. The other categories of reserves, C_2, D_1, and D_2, are simply inferred reserves not established by drilling.

We believe that proved reserves in the US sense correspond to the Soviet A reserves plus some fraction of adjacent B reserves. The remainder of the B reserves and some of the C_1 reserves would fall into the US category of probable. Much of the remainder of the C_1 reserves fall into the US possible category. Moreover, some portion of Soviet B and C_1 reserves are not exploitable with current technology and equipment.

The Size of Soviet Oil Reserves, 1946 to 1975

Our estimates of Soviet oil reserves are based on recently published reserve growth indexes (link-relatives), which track Soviet oil reserves from 1947 through 1971, and two statements that indicate the reserve developments for the period 1971 through 1975. According to Professor Robert Campbell, the Soviet Union had 2.8 billion barrels (390 million tons) of A and B reserves in 1946. Taking that figure as a base, he applied a Soviet link relative published in 1969 to derive an estimate of 19 billion barrels (2.6 billion tons) of oil in Soviet A and B reserves on 1 January 1961. A 1974 Soviet publication reported that reserves had grown by 63 percent (1.63 times) between 1 January 1961 and 1 January 1972. Applying this growth factor to the 1961 estimate yields a 1972 estimate of 31 billion barrels (4.2 billion tons).

To estimate Soviet A and B oil reserves on 1 January 1976, we have again resorted to the recent Soviet literature. A 1975 planning index published in a leading journal indicated that reserves would increase by 30 percent during the 1971-75 period. This would yield an estimate of roughly 40 billion barrels (5.5 billion tons) for A and B reserves as of 1 January 1976. Of this amount, 33 billion barrels (4.5 billion tons) can be considered reliable A reserves proved by drilling operations. We can verify this from exploratory drilling discovery rates. During 1946-75, about 80 million meters of exploratory drilling for oil were reported by the Soviet Oil Ministry. An estimated average finding rate of 130 tons per meter for the 30 years would yield gross additions of 76 billion barrels (10.4 billion tons). Subtracting cumulative production of 43 billion barrels (5.9 billion tons) during 1946-75 leaves 33 billion barrels (4.5 billion tons) of remaining A reserves at the start of 1976.

The 33 billion barrels (4.5 billion tons) of Soviet A reserves plus a small portion of the 7.3 billion barrels (1 billion tons) of B reserves roughly corresponds to the US definition of proved reserves. The remainder of the B reserves and some fraction of the C_1 reserves correspond to the US definition of probable reserves. As a result, based on the literature, we estimate Soviet proved oil reserves (US definitions) at between 30 and 35 billion barrels (4.1 to 4.8 billion tons) as of 1 January 1976 and that proved and probable reserves would amount to about 40 billion barrels (5.5 billion tons).

The US Reserve Analogue

Soviet oil reserves can also be calculated by using the United States as an analogue. The Urals-Volga and other old producing regions are roughly similar to the lower 48 states, particularly in that the combined output of all regions except West Siberia stabilized at 340 million tons (6.8 million b/d) in 1974 and 1975, and then declined in 1976. West Siberia, on the other hand, is much like Alaska, in that in the years ahead growth in Siberian output is expected not only to offset continued declines in other regions but also to allow for substantial growth in output.

Based on a close comparison with the United States, Soviet proved reserves outside of West Siberia probably total at most only 17-18 billion barrels (2.3-2.5 billion tons) and could total only about 14 billion barrels (1.9 billion tons). US output of 420 million tons (8.4 million b/d) in 1975 came from a working proved reserve base of only 23 billion barrels (3.2 billion tons).* Applying this reserve production ratio for US working reserves (7.5) to Soviet output outside of West Siberia yields a working reserve base of 18 billion barrels (2.5 billion tons) for all regions except West Siberia. Because of the intensive exploitation of reserves, through massive water flooding and use of high-lift pumps, the reserve production ratio is probably only 5 or 6. The extremely rapid depletion rate of capacity in these older fields tends to confirm use of a reserve/production ratio as low as 6. On this basis, reserves outside of West Siberia would total only about 14 billion barrels (1.9 billion tons).

West Siberian proved reserves probably total some 18-24 billion barrels (2.5-3.3 billion tons). Remaining reserves in Samotlor range from 7.5 to 11 billion barrels (1-1.5 billion tons), depending on ultimate recovery rates. Initial reserves of about 14-15 billion barrels (1.9-2.0 billion tons) were calculated on the basis of recovery of 40 some percent of the original oil in place. More recent information indicates that recovery will only reach

*Total proved reserves of 35.3 billion barrels (4.8 billion tons) in 1975 less 9.6 billion (1.5 billion tons) for North Slope reserves and 2.5 billion (340 million tons) in Naval reserves and the Santa Barbara Channel.

some 26 percent, while the urgency of Soviet plans for gas-lift equipment and the extremely rapid rise in water cut could mean recovery will be even lower. Thus, our best estimate for remaining recoverable reserves at Samotlor on 1 January 1977 is 7.5 billion barrels (1 billion tons), initial reserve of about 11 billion barrels (1.5 billion tons) less cumulative production off 3.1 billion barrels (425 million tons).

Using the same reserve production ratio for other producing West Siberian fields as that at Samotlor (8 if average recovery is 26 percent and 12 if recovery reaches 36 percent), indicated reserves of 4-6 billion barrels (550-820 million tons) remain to be exploited at other producing fields.

In addition to fields already in production in West Siberia, the USSR has plans to develop a large number of smaller fields over the next four years. According to their plans these fields are expected at their peak development to add production of 90 million tons (1.8 million b/d). Using an R/P of 12, the same as that for Samotlor's peak output vs initial recoverable reserves, yields 8 billion barrels (1.1 billion tons) of additional proved reserves not yet in production.

Conclusion

Use of the US analogue technique results in an estimate of total proved reserves for the USSR of 33.5 billion barrels (4.5 billion tons) in 1976. The estimate, on a regional basis, is as follows:

	Billion Barrels	Billion Tons
Total	**33.5**	4.5
Old producing regions	14.0	1.9
West Siberia	19.5	2.6
Samotlor	7.5	1.0
Other producing fields	4.0	0.5
Proved nonproducing	8.0	1.1

Prospects for Soviet Oil Production

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April 1977

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FOREWORD

This report is the unclassified version of the recent CIA study on Soviet oil production which provided the basis for the evaluation of the Soviet oil industry contained in our recent publication, "The International Energy Situation: Outlook to 1985."

Our analysis of the Soviet oil industry results primarily from a detailed review of Soviet publications and a comparative study of these results with information freely available from all other sources on the economics of the world oil industry. These include studies of the technical aspects of oil production, reserves and demand, and their relationship to general developments in the Soviet economy.

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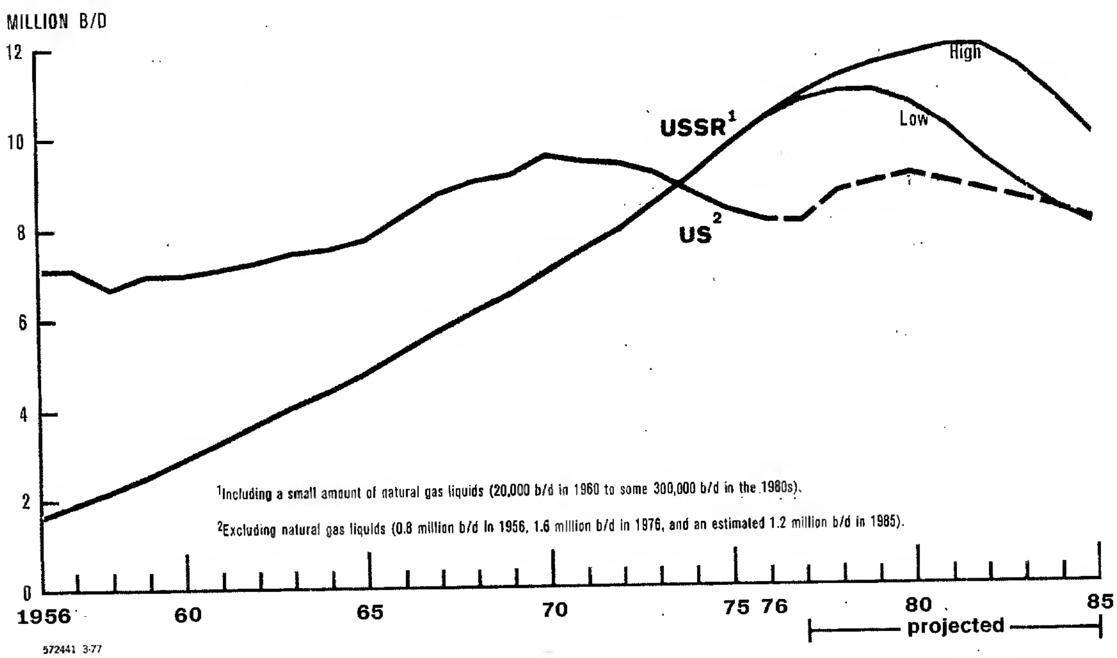
Prospects for Soviet Oil Production

April 1977

The Problem

1. Unlike the United States, which has long restricted production for reasons of conservation and profit, the USSR favors a forced draft approach. Short-term production goals are considered floors, not ceilings, and rewards are given for exceeding them with little regard to productivity over the longer term. Under these conditions, Soviet production has expanded much more rapidly in the last 20 years than that of the United States.

Soviet and US Crude Oil Production FIGURE 1



[1]Including a small amount of natural gas liquids (20,000 b/d in 1960 to some 300,000 b/d in the 1980s).

[2]Excluding natural gas liquids (0.8 million b/d in 1956, 1.6 million b/d in 1976, and an estimated 1.2 million b/d in 1985).

2. The Soviet stakhanovite approach has led to (a) an emphasis on development drilling over exploration, with the result that new discoveries are failing to keep pace with output growth; (b) overproduction of existing wells and fields through rapid water injection and other methods, with the result that less of the oil in place is ultimately recovered; and (c) new capacity requirements that soon will run far beyond the Soviet oil industry's capability.

USSR: Production of Crude Oil,[1] by Region

Million Barrels per Day

	1970	1975	1980 Goal	CIA Estimates of Peak Output: High	CIA Estimates of Peak Output: Low
Total	**7.06**	**9.82**	**12.80**	**11.8**	**11.0**
Western region and Urals	**5.80**	**6.00**	**5.71**	**5.6**	**4.9**
Urals-Volga	4.17	4.50	NA	4.1	3.5
Tartar	2.01	2.07			1.5
Bashkir	0.81	0.81	2.85	2.9	0.6
Kuybyshev	0.70	0.69			0.5
Perm'	0.32	0.45	0.62	0.6	0.5
Orenburg	0.15	0.24			
Lower Volga	0.14	0.14		0.6	0.4
Udmurt	0.01	0.07			
Saratov	0.03	0.03			
Belorussia	0.08	0.16	1.74	0.2	
Caucasus	0.69	0.47		0.3	
Azerbaydzhan	0.41	0.35		0.4	1.0
Ukraine	0.27	0.23		0.2	
Other	0.03	0.07		Negl	
Komi and Arkhangel'sk	0.15	0.22	0.50	0.4	0.4
Eastern region	**1.26**	**3.82**	**7.09**	**6.2**	**6.1**
West Siberia	0.63	2.96	6.16	5.2	5.2
Central Asia	0.58	0.82	NA	0.9	0.8
Mangyshlak	0.21	0.40	0.54		
Emba	0.05	0.08			
Turkmen	0.29	0.31	0.28		
Other	0.03	0.03			
Sakhalin	0.05	0.04	0.11	0.1	0.1
Other	Negl	Negl			

1. Including gas condensate.

3. As the ratio of reserves to output has fallen, the bulk of Soviet output has come increasingly from fields approaching exhaustion. The result has been an acceleration of drilling requirements, which will level off or decline only when--and if--very large new additions are made to the producing reserve base. The Soviets speak of this problem in terms of the depletion offset--the amount of new capacity required to offset depletion of old capacity in each 5-year plan period.

4. During the 1961-65 plan period, only 1.3 million b/d (67 million tons per year) of capacity had to be replaced. In 1971-75, 5.1 million b/d (254 million tons per year) of replacement capacity was required because of rapid depletion. Viewed in another way, about 72 percent of 1970 capacity had to be replaced by the end of 1975. The target for the 1976-80 plan is 10.6-10.8 million b/d (530-540 million tons per year) of new capacity; 7.8 million b/d–equal to about 80 percent of the capacity on line in 1975–is to offset depletion. If depletion is more rapid than the Soviets expect–and, based on their past record, it may well be--considerably more of the 1975 capacity will have to be replaced.

Reserves

5. There is uncertainty about the size of the USSR's reserves, because of definitional problems as well as Soviet secrecy. Our best estimate is that Soviet proved reserves are 30-35 billion barrels, roughly comparable with those of the United States. There is no doubt that Russian proved reserves have been falling in recent years, and there is very little chance that enough new oil will be discovered during the next few years to appreciably improve the reserves-to-production ratio. Indeed, despite major efforts it will probably deteriorate further.

6. Although the USSR has abundant potential reserves in Arctic, East Siberian, and offshore areas, development of such reserves is at least a decade away. Thus, during the next 8-10 years, almost all Soviet output will have to come from existing fields and from new fields in existing producing regions.

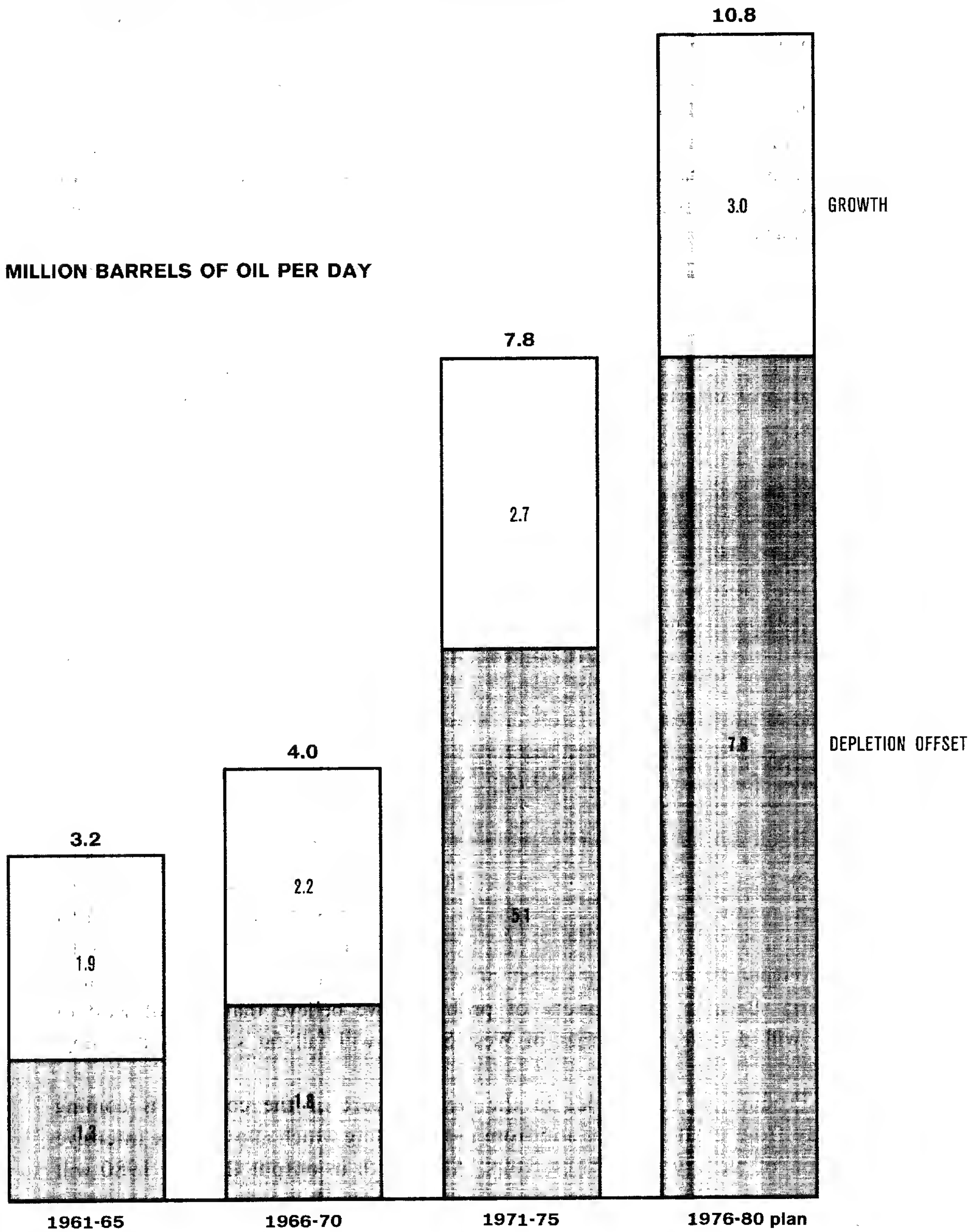
The Outlook for Output from Existing Production Regions

7. From World War II through 1970, the growth in Soviet oil output came either from the Caspian fields or, after the mid-1950s, from large fields in the Urals-Volga region. Since 1970, nearly all output growth has come from West Siberia, primarily from the giant Samotlor field. Current Soviet plans call for holding aggregate output nearly constant west of the Urals, while doubling production in West Siberia. Because of a variety of problems, we believe that output west of the Urals will decline, while that of West Siberia will fall far short of doubling.

8. Production from fields in the western part of the country is coming increasingly from greater depths and from in-fill drilling which allows more intensive exploitation of already tapped reservoirs. All growth in output through 1980 will

USSR: Additions to Oil Producing Capacity

FIGURE 2



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come from West Siberia, where the inhospitable climate, difficult terrain, and vast distances greatly complicate operations. In 1976, approximately 60 percent of West Siberian output and roughly one-fifth of national production came from the giant Samotlor field on the middle Ob'. Soviet sources indicate that this field will reach peak production in the next year or so and will hold peak levels for no more than 4 years. It is already experiencing rapid water incursion. The water cut reached 47 percent in 1975, and increasing quantities of fluid (water plus oil) must be lifted to recover any given quantity of oil. Although new fields are being discovered in West Siberia, no giant fields comparable to Samotlor have been found.

The Drilling Problem

9. The USSR does not have the drilling capability to pursue adequate development and exploration programs simultaneously. The Soviets have some 1,600 active rigs, about the same as the United States. In terms of meters drilled, however, the Soviet effort amounts to only about one-fifth that of the United States. In 1971-75, the Soviet Ministry of the Oil Industry drilled a total of about 52 million meters. In 1975 alone, the United States drilled 53 million meters with about 1,700 rigs. We estimate that, even with a maximum effort, the Soviets will not be able to come close to drilling by 1980 the 75 million meters called for by their current 5-year plan.

10. The poor Soviet drilling record is in part the result of the fact that 80 percent of their drilling is done with turbodrilling rigs that are highly inefficient for deep drilling or for use in soft formations.

The Fluid Lifting Problem

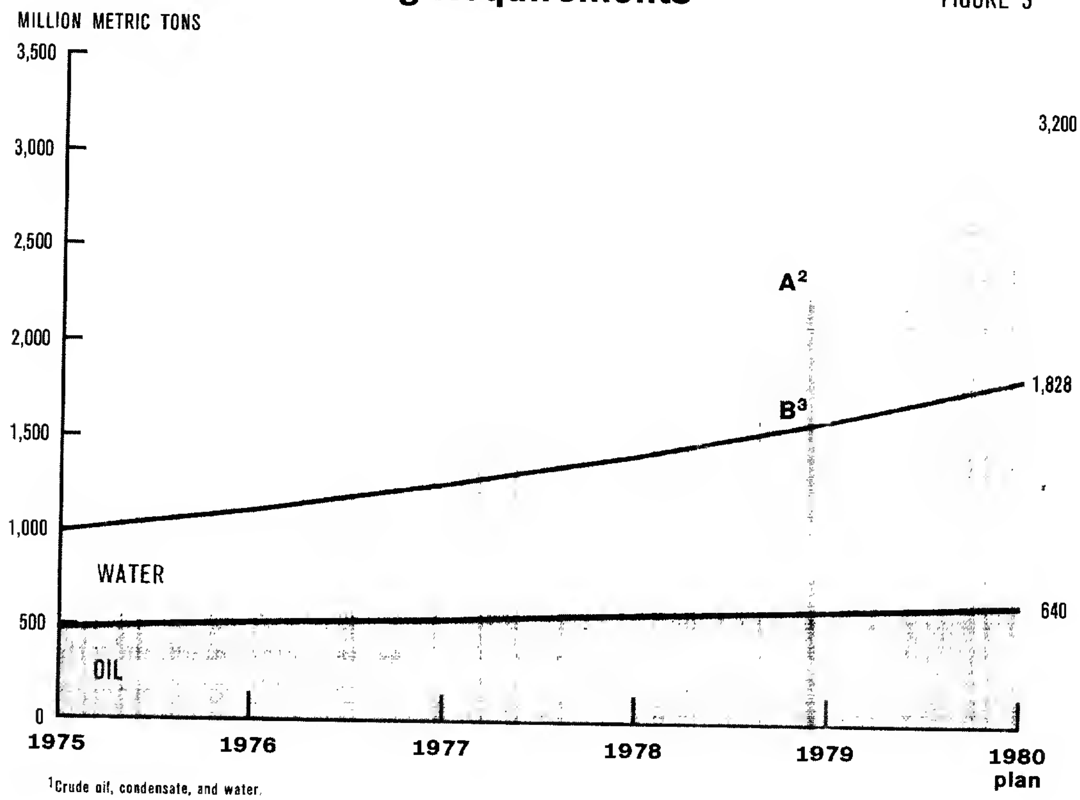
11. In the 1950s, when wells in the Urals-Volga region began to stop flowing naturally, the Soviets were forced to begin pumping. At that time, however, pumping equipment was in short supply. To forestall a slowdown in the growth of oil output, the Soviets adopted the practice of massive water injection within and along the edges of each field. If enough water is forced into a formation, it raises reservoir pressures so that wells once again flow without pumping. The Soviet system differs from the standard Western secondary recovery technique of

waterflooding in that the object is to increase rather than just to maintain pressure. Much more water is injected than oil produced.

12. Although massive water injection can boost production for a time, eventually the water will find a channel of least resistance and break through to the oil-producing well, a process that leaves behind much oil in the less permeable portions of the formation. When the wells begin to show water in large quantities, the natural flow will usually stop and the wells must be pumped. In this case, however, conventional pumping equipment cannot be used; special high-capacity submersible pumps are needed because much greater volumes of fluid (water plus oil) must be lifted.

13. Such pumps began to be used extensively in the USSR in the late 1960s. In 1973, these pumps provided 2.5 million b/d of the Soviet total of 8.6 million

USSR: Fluid Lifting Requirements[1] FIGURE 3



[1]Crude oil, condensate, and water.

[2]Water which constituted 50 percent of liftings in 1975 will rise to 80 percent in 1980.

[3]Water which constituted 50 percent of liftings in 1975 will rise to 65 percent in 1980.

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b/d. The Soviets had some 12,000 of these pumps in 1975, and their need for such equipment is increasing rapidly as water encroachment becomes a problem in more and more fields. As an alternative to high-capacity submersible pumps, at least in some fields the Soviets are considering wider use of gas-lift equipment.

The Longer Term Outlook

14. The initial falloff, when it comes, will almost certainly be sharp; thereafter output may continue to fall sharply, level off, or perhaps even increase as new fields are brought into production in frontier areas. There is no question that new fields–some quite large--will eventually be discovered. Given the rapid rate of depletion of existing fields and the technical difficulties associated with exploration and exploitation in frontier areas, however, we doubt that the new discoveries will come on stream rapidly enough to do more than temporarily arrest the rapid slide of Soviet output.

15. As we stated earlier, only small amounts of Soviet production during the next decade will come from outside existing producing areas. In the early 1980s new offshore Caspian reserves may make some small contribution to output, as will new discoveries on the Mangyshlak Peninsula on the east shore of the Caspian and in the Pechora region west of the Urals. The Soviets also hope to find oil in deep structures in the northern part of West Siberia's Tyumen' Oblast. Limited exploration in this region, however, has so far yielded mainly natural gas and condensate.

16. Geological conditions favorable to large future discoveries exist over much of the Arctic offshore regions (especially in the Barents and Kara Seas), in the East Siberian lowlands, in deep structures in the Caspian area, and perhaps off Kamchatka and Sakhalin in the Sea of Okhotsk. Production from most of these areas, however, is at least a decade away. In the offshore Arctic, environmental

conditions are much more severe than in the North Sea; technology for exploration and production in this region does not yet exist, even in the West. Although conditions are more favorable near Sakhalin and in the East Siberian lowlands, production and transportation difficulties make it doubtful that significant production could take place until 10 years after a major discovery--which has yet to be made. The lead time would be shorter for production from deep wells in the Caspian region; the USSR, however, lacks the equipment and experience necessary to undertake a deep drilling program without extensive Western help.

Economic Implications

17. When oil production stops growing, and perhaps even before, repercussions will be felt on the domestic economy of the USSR and on its international economic relations. The extent of such repercussions can be only guessed at without further research. At a minimum, the USSR will find it difficult to continue to simultaneously meet its own requirements and those of Eastern Europe while exporting to non-Communist countries on the present scale. More pessimistically, the USSR will itself become an oil importer.

18. These are important considerations for the Soviet Union. It now supplies three-fourths of the oil required by the Communist countries of Eastern Europe. For many years the export of oil to non-Communist countries, mainly in Western Europe, has been the USSR's largest single source of hard currency.

19. In the long run, considerable substitution for oil will be possible domestically and perhaps in export markets as well. The USSR has large reserves of coal and natural gas. Development of these reserves will take time and large capital investments. The cost of Soviet energy almost certainly will increase. The largest known gas reserves are in permafrost zones of Siberia where production and transportation will be difficult. Deposits of coal scheduled for exploitation in the next decade are also east of the Urals; considerable investment in transport facilities and on-site thermal powerplants and other coal-using industrial facilities will be required.

20. Electric power from hydroelectric and nuclear powerplants will make only a small contribution for many years to come. Although there are vast hydroelectric resources in Eastern regions of the USSR, the technical problems of long-distance

transmission must be solved before such resources can be fully exploited. The Soviets consider nuclear power to be the best source of new electric power in European areas. A program for constructing nuclear powerplants is under way, but it will be quite some time before these plants can have an important effect on the power base. In 1975 nuclear power represented 2 percent of total power production, and it will reach only about 6 percent in 1980.

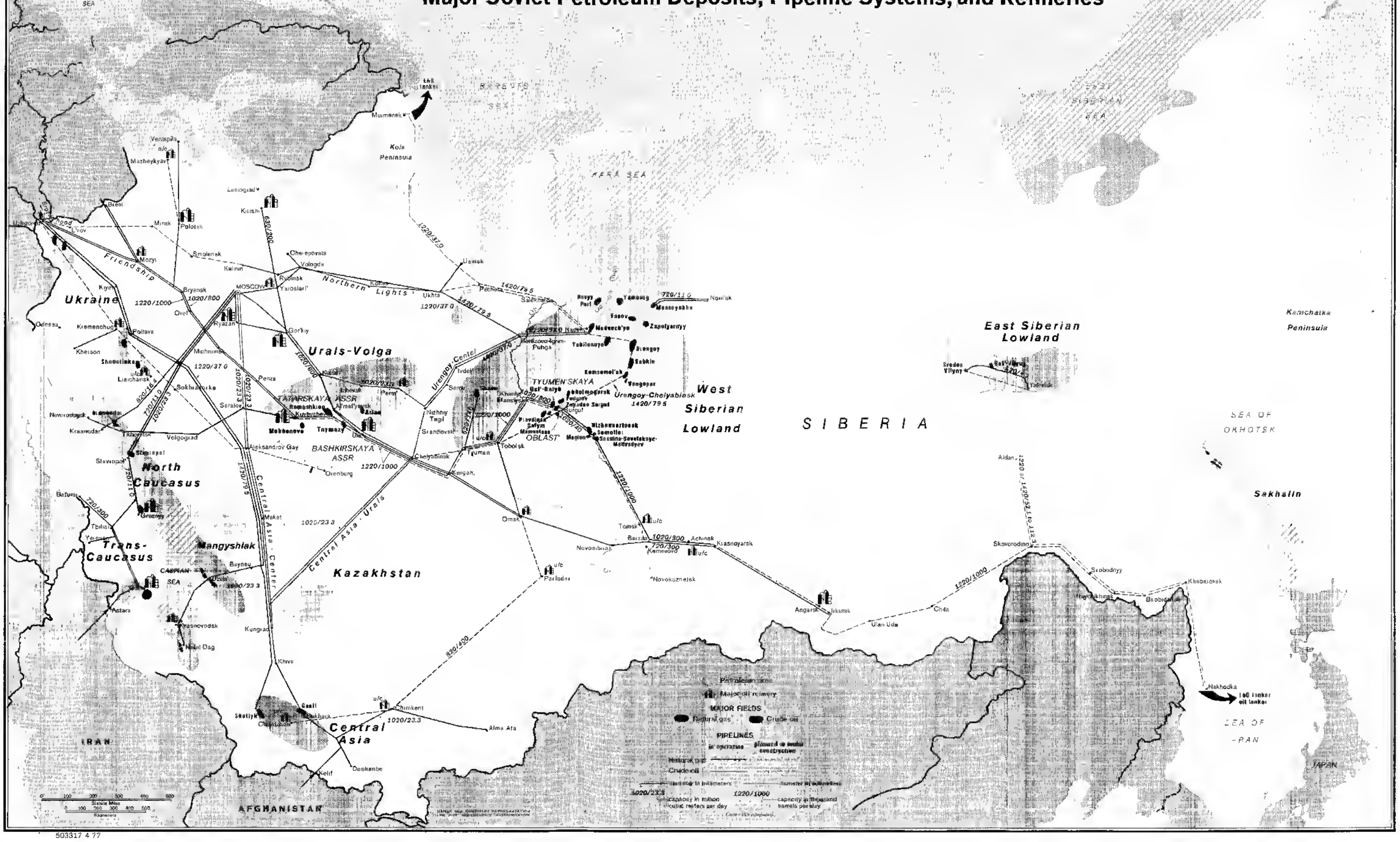
Summary

Soviet oil production will soon peak, possibly as early as next year and certainly not later than the early 1980s. The maximum level of output reached is likely to be between 11 and 12 million barrels per day (b/d)—up from the 1976 level of 10.4 million b/d. Maximum levels are not likely to be maintained for long, however.

The Soviets have two basic problems: one of reserves and one of production. Barring an extremely unlikely discovery of a massive new field close to an existing field, new deposits will not be found rapidly enough to maintain acceptable reserves-to-production ratios, and those fields that account for the bulk of Soviet production are experiencing severe water encroachment. As a result, increasingly large quantities of water must be lifted for each barrel of oil produced, and high-capacity submersible pumps will be required if production declines are to be staved off even temporarily.

During the next decade, the USSR may well find itself not only unable to supply oil to Eastern Europe and the West on the present scale, but also having to compete for OPEC oil for its own use. This would be a marked change from the current situation, in which exports of oil to the West annually provide 40 percent of total Soviet hard currency earnings. The USSR has large reserves of coal and natural gas, but those scheduled for exploitation over the next decade are east of the Urals, far from consuming centers in the western USSR. Distance, climate, and terrain will make exploitation and transport difficult and expensive. Exports of gas will increase, but will not compensate for the loss of earnings from the export of oil. Although some substitution of coal and gas for oil in domestic use will be possible in the long run, the effect of such substitution will be minimal in the short run. Neither hydroelectric power transmitted from the east nor construction of nuclear electric plants (mainly in the western USSR) can be expected to afford much relief in the Soviet energy situation for more than a decade.

Major Soviet Petroleum Deposits, Pipeline Systems, and Refineries



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